UNIV MICROFILMS INC
313 N FIRST ST
ANN ARBOR MICH
12/61 0 ¢

ELECTRICAL WEST

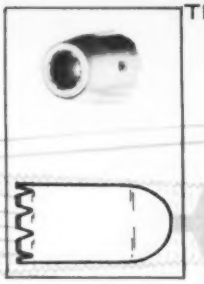
SEPTEMBER 1961

A McGRAW-HILL PUBLICATION

NUCLEAR REPORT | Norm Sutherland and this team will build Bodega Park.

SPLICE and DEADEND

AAC, AAAC AND COPPER . . . WITH

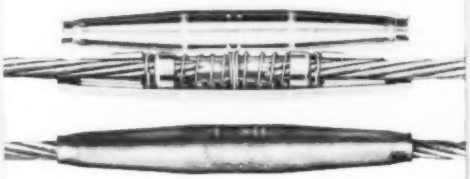


RELIABLE "55" SERIES

PILOT CUP TYPE

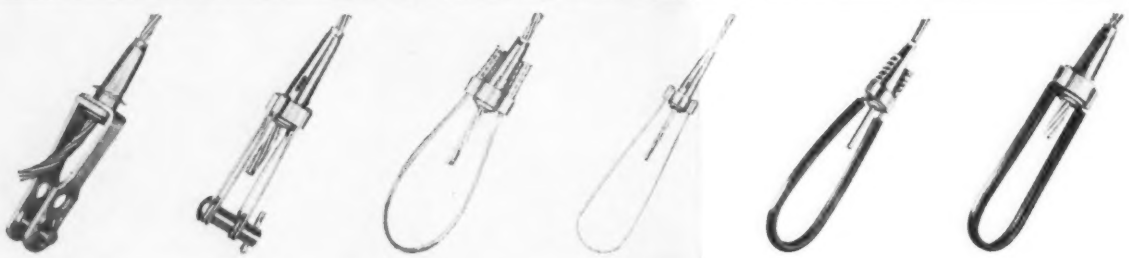
Pilot cup, factory installed in Reliable tension splices, either caps or refuses bent, out-of-lay or burred strand. The chuck cannot engage the conductor until the pilot cup, enclosing strand ends, has been run completely through the chuck. THUS ONLY SOUND CONDUCTOR IS POSITIONED WITHIN THE GRIPPING AREA.

Tensile tests prove the ability of these splices and deadends to hold 100% of the book rated strength of the conductor — AAC, AAAC or copper.



Catalog Number	AAC 7 Strand	AAAC 5005
AL5547	4	5
AL5527	2	3
AL55101	1	2
AL55107	1/0	1
AL55207	2/0	1/0
AL55307	3/0	2/0
AL55407	4/0	3/0
AL55266.8	266.8	4/0

FEED-THRU DEADENDS



"LINES UP"
Reliable's latest movie tells the whole story. Be sure to see it.

During twenty-seven years of continuing production it has never been reported that a Reliable Feed-Thru Deadend chuck let go a line

Reliable

ELECTRIC COMPANY Franklin Park, Illinois

A Symbol of Integrity Since 1909

Is Profit Really "Profit"?

Profit to most people means the difference between what something costs and its selling price. What most people forget is the fact that out of this difference the costs of running the business must be paid.

Let's take your neighborhood hardware merchant. He has hundreds of interesting items and gadgets on display that he buys for a certain price and sells for some higher figure. The difference is what accountants call the "gross profit." It's quite common in retail stores to double the buying price to make the sale price. So some people would say that he's making 100% profit and that's too high. Let's stop to consider for a moment. Out of this difference in price between buying and selling, the hardware store owner must pay the rent on his store, the employees' pay checks, bills for lighting, heating, wrapping materials, signs and advertising, all the local license fees and taxes, and many other similar expenses. This eats up a big share of the gross profit. If he has anything left over, the accountants call it "net profit." Then Uncle Sam steps in and takes anywhere from 30 to 52% of what's left as income tax, leaving the owner with only a small fraction of the total dollars he rang up in his cash register. Many people think that what's left is profit but this is still not true.

The owner has invested many thousand dollars of his savings to buy stock in the store, showcases, cash registers and many other items needed to operate the business. When he decided to go into the hardware business, he hoped that his net profit after taxes would be enough to pay him at least as much as he might have realized had he invested that same amount of money in real estate, corporate bonds or some other venture that was willing to pay rent on borrowed money. In other words, the money that is left over after paying all of the expenses of operating the business plus the income taxes should be looked upon as a **return on the investment necessary to keep the business going**—not as "profits."

Competition Applies the Brakes

Some types of businesses often show a very high rate of return on invested capital but, under our free choice system, other people soon spot a good thing and start in competition. This in turn tends to divide the market and reduce excessive return on the investment. The over-all result is to set a general "rate of return" for money that may vary from 3 to 10%, depending upon the amount of risk involved in the investment. Thus profits can be said to represent rent on money invested in a given enterprise.

An electric utility is an excellent example of a business that can't make any profit at all. In most states it is regulated and its rates are set by a commission, which limits its rate of return on the investment in the system, **used and useful in the public service**, to something between 6 and 7%. It's important to note that the commission can determine how much of the system **is** used and useful in the public service. This means that utility management must be particularly watchful over system additions and operating efficiency because there is a definite ceiling on the company's earning power.

Or let's take you and me as individuals who also have something to sell. As employees of a big corporation, we invest our time, skill and energy in return for a pay check. After we pay for all our living expenses, what's left over is a measure of the return on our investment in ourselves. Highly professional people who have spent years in education and training normally have more left over, or a higher return, than do those of us who have fewer talents to offer society.

All of this has a very important bearing on our way of life because our whole system of living and of government depends upon individuals, businesses, companies and corporations making a reasonable return on their investments. The whole tax structure of the country is based on taking a portion of that rate of return to support government operations. Individuals are taxed on the total amount of the money they take in from their work. Corporations are taxed on the money that is left after paying all expenses of the business **except** the return to the investors. Thus our whole social structure depends upon the earning power of all of us, individually and collectively. In subsequent articles in this series some of the factors affecting that earning power will be discussed.

The Profit Squeeze On Two Fronts

. . . which leaves just enough for mortgage and insurance

. . . which leaves enough to pay 5% to our shareholders

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Cover — N. R. Sutherland of PG and E and the company's nuclear team, C. C. Whelchel (seated), W. J. Lindblad, J. F. Bonner, F. F. Mautz (standing). Photo by George Waters.

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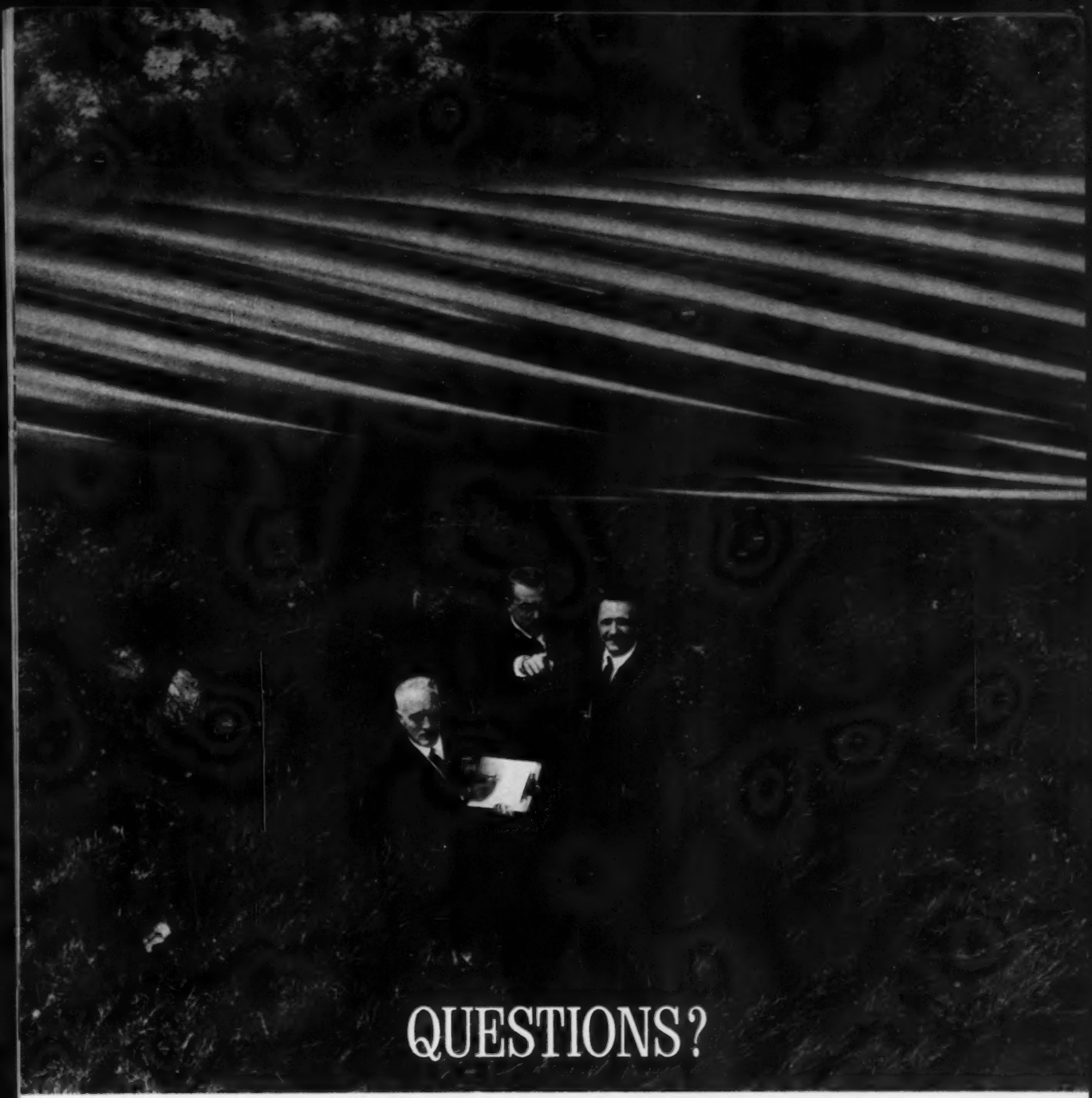


QUESTIONS?

We have answers to some you haven't asked yet

At the Alcoa® works in Massena, New York, you'll find the world's largest single facility devoted exclusively to research on aluminum conductor and accessories.

The job assigned to these people and their extensive equipment is this: Test. Try. Re-test. Try again. Evaluate what's been done, what's being done, what should be done.

Find out anything and everything that applies to overhead aluminum conductor. Electrical load. Temperature. Tension. Vibration. Connection.

And finally, *anticipate*. Be able to answer questions before they are asked. Because pioneering is a continuous obligation.

Our past accomplishments in all forms of aluminum conductor you may already be familiar with. The future we'd like to help you work on now.

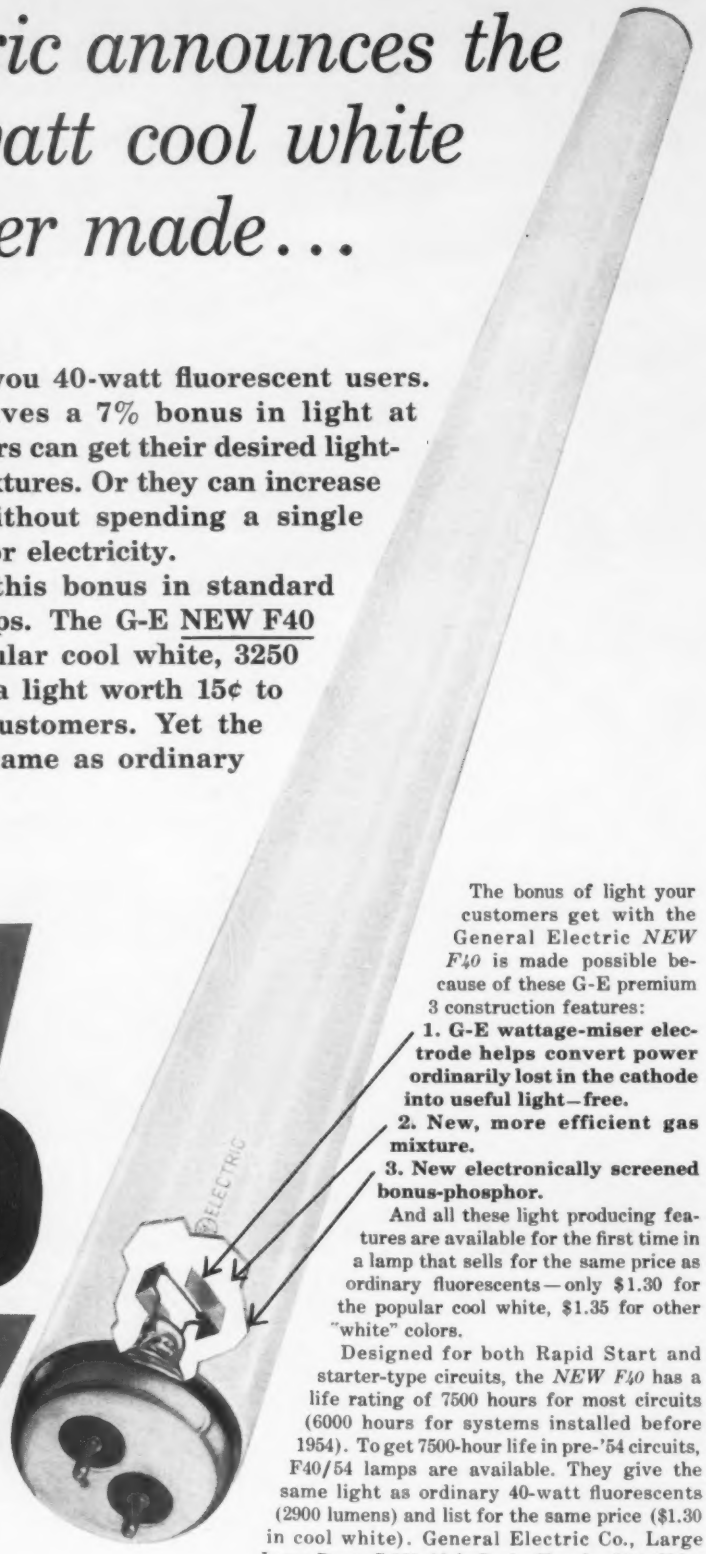
If you'd like to know more about the many subjects on which we can provide answers, write to Rome Cable Division of Alcoa, Dept. 4-91, Rome, New York.

ALCOA
ROME CABLE
DIVISION

General Electric announces the brightest 40-watt cool white fluorescent ever made...

Here's money-saving news for you 40-watt fluorescent users. General Electric's NEW F40 gives a 7% bonus in light at no extra cost. Now your customers can get their desired lighting level with fewer lamps and fixtures. Or they can increase their existing lighting level without spending a single extra penny for lamps, fixtures or electricity.

Only General Electric offers this bonus in standard 40-watt "white" fluorescent lamps. The G-E NEW F40 is rated at 3100 lumens in popular cool white, 3250 in white or warm white—extra light worth 15¢ to 30¢ a lamp to most of your customers. Yet the list price for this lamp is the same as ordinary fluorescents.



NEW F40 ONLY 1.30 LIST

The bonus of light your customers get with the General Electric *NEW F40* is made possible because of these G-E premium 3 construction features:

1. G-E wattage-miser electrode helps convert power ordinarily lost in the cathode into useful light—free.

2. New, more efficient gas mixture.

3. New electronically screened bonus-phosphor.

And all these light producing features are available for the first time in a lamp that sells for the same price as ordinary fluorescents—only $1.30 for the popular cool white, $1.35 for other "white" colors.

Designed for both Rapid Start and starter-type circuits, the *NEW F40* has a life rating of 7500 hours for most circuits (6000 hours for systems installed before 1954). To get 7500-hour life in pre-'54 circuits, F40/54 lamps are available. They give the same light as ordinary 40-watt fluorescents (2900 lumens) and list for the same price ($1.30 in cool white). General Electric Co., Large Lamp Dept. C-121, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

For phone number of closest representative see advertising index in back of book.

For your convenience— the *complete* line of crimp connectors, No. 22 to 2,000,000 CM. Copper and aluminum lugs, splices, etc., and tools.

TYPE HVJR

TYPE BLU

Crimp

Pioneers in fast economical welding of aluminum bus, Penn-Union is your best source of weld fittings —and *technical help.*

TYPE WLA

TYPE WTFA

Weld

Your choice of

ALL 4 ways

from Penn-Union

Solder

TYPE SL

TYPE SL

Once the standard connection, still widely used. Single and two-hole lugs, No. 10 to 2,000,000 CM.

Bolt

TYPE RA

TYPE VVL

Many types of bolted lugs, splices, bus fittings, No. 12 to 2,500,000 CM. Copper and aluminum.

TYPE LD

Sold by Leading Electrical Distributors

PENN-UNION

a good connection

PENN-UNION ELECTRIC CORP., Erie, Pa.

Export Sales—Philips Export Co., 100 East 42nd St. New York 17, N.Y.

Canadian Sales—Dominion Cutout Co., Ltd., Toronto

When You First Put It Up...
Any 6M Strand will
ALUMOWELD
thick
aluminum covering
controlled
atomic weld
strong steel core

support 6,000 lbs...

TIME BRINGS OUT THE DIFFERENCE

RUSTABLE STRAND GETS WEAKER— ALUMOWELD STRAND KEEPS ITS STRENGTH

When you buy strand you want the strength you specify—and you want that strength to last. So why waste good money on ordinary strand that can't resist corrosion—that starts to rust away and weaken *after* you install it. Unlike rustable strand, Alumoweld's initial strength remains permanent year after year.

With its *thick* covering of aluminum—25% by area—permanently welded to a strong steel core, Alumoweld gives you the same high resistance to corrosion as solid aluminum. It's made by the exclusive atomic-welding process in which the ductile weld remains permanent under all operating conditions. Corrosive elements can't reach the steel core because of the durable protection of the *thick* aluminum covering.

Diameter for diameter, Alumoweld Strand has the same strength as extra-high-tensile steel—yet, it weighs less and is easier to install. Its initial cost is surprisingly low. In fact, because it will stay up far longer, Alumoweld Strand will actually *cost less* as the years go by.

Alumoweld Strand gives you performance where it counts—on the job! Send for Engineering Bulletin E. D. 3000 and get the full story on Alumoweld's important, money-saving advantages. You'll see why Alumoweld Strand is preferred by so many efficiency-minded, cost-conscious companies.

Supplies of Alumoweld Strand are available for immediate shipment from our warehouses in New York, Chicago, Pittsburgh and Memphis.

COPPERWELD STEEL COMPANY WIRE AND CABLE DIVISION *Glassport, Pa.*

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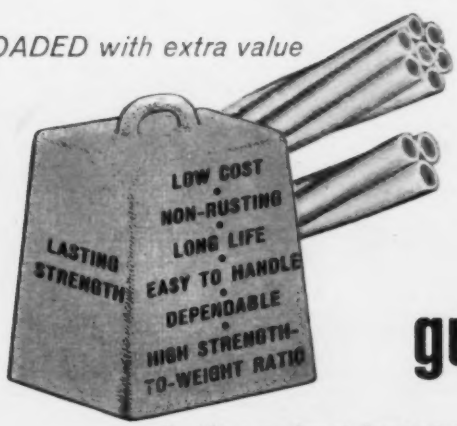
LOADED with extra value



ALUMOWELD

guy and messenger strand

For phone number of closest representative see advertising index in back of book.

We're a grown-up company with young ideas!

Progressive engineering is our by-word and continuing to be progressive means that you can not rest on the laurels of past success. Young ideas . . . based on successful experience . . . enables Circle A-W to bring to the trade a constant flow of newly developed and proven products.

Our model is Miss Judy Floyd, five year old granddaughter of Circle A-W's President, Mr. Al Johnson.

One of many examples of Circle A-W progressive engineering is this all-in-one, surface and flush mounting metering device. Easy installation, along with many other important features, is bringing high trade acceptance to this unit. Raintight and UL approved . . . means built-in reliability.

CIRCLE A-W PRODUCTS Co.
P.O. Box 1171, Modesto, Calif.

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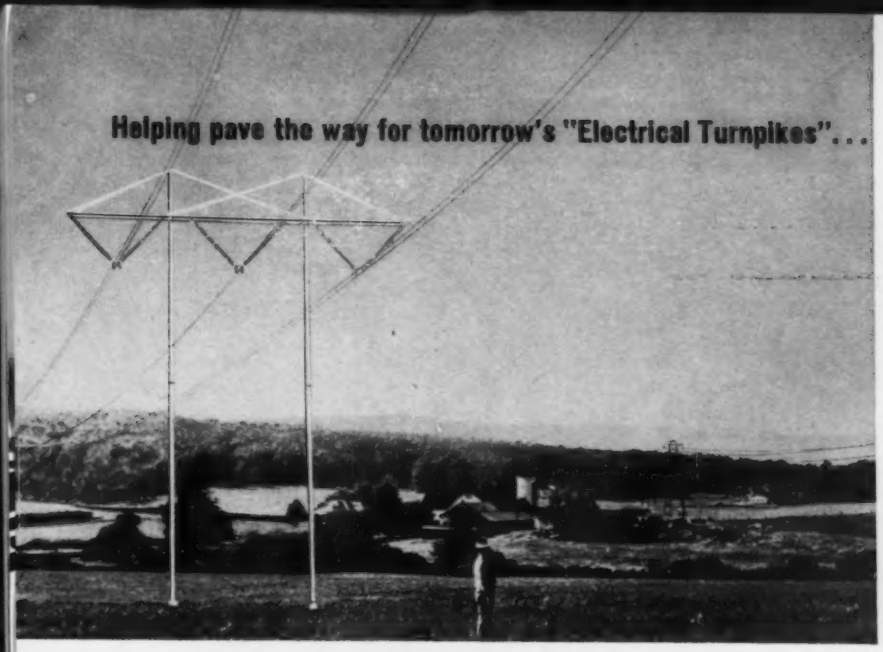
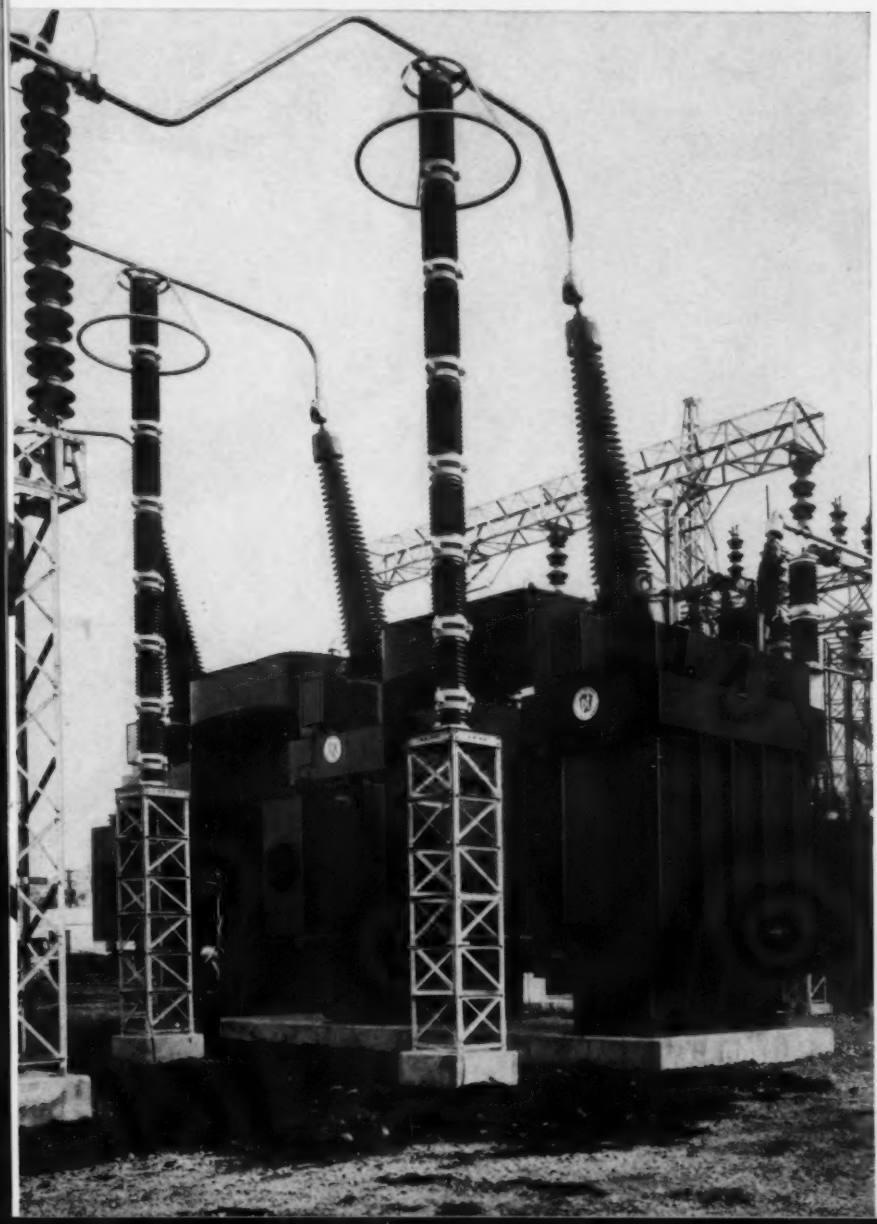


500-kv Pennsylvania transformers now in service on Penelec's EHV line



The 500,000-volt transformers provided by Pennsylvania Transformer Division, McGraw-Edison Company for Pennsylvania Electric Company's pioneering transmission line are the culmination of a million-dollar investment by Pennsylvania in the development of extra-high-voltage transforming equipment. During the next two years, operating data obtained in cooperation with Penelec will help pave the way for eventual EHV "electrical turnpikes" over which large blocks of power can be transmitted economically.

Located at the Saxton end of the 13-mile Penelec line, the bank of Pennsylvania autotransformers is rated 60,000 kva, 500-115 kv. The installation consists of three 20,000-kva single-phase units.

Although now in the realm of the "spectacular," extra-high-voltage installations such as this undoubtedly will play an important part in America's future growth. Pennsylvania Transformer is grateful for the opportunity to help lay a solid groundwork for that future by participating in the Penelec project.

The 500-kv transformers were built with Pennsylvania's basic shell-form insulation system—service-proved in Pennsylvania Contour Design Transformers. For details, write for Catalog P-560.

PENNSYLVANIA TRANSFORMER DIVISION
McGRAW-EDISON COMPANY
CANONSBURG, PA.

HILLER 12E
N5

From Crossarms to Complete Towers...

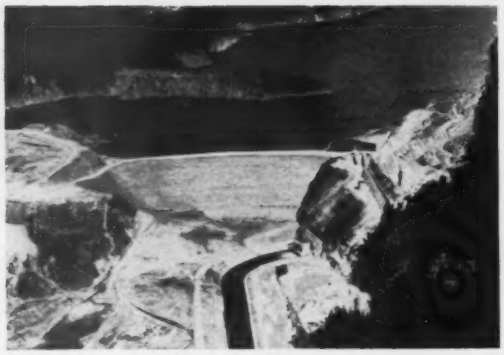
Alcoa® Aluminum. Dropped from the air or built straight up. ■ Designed and fabricated by Alcoa Structural Division for economy — speed — strength.

Write:
Aluminum Company of America
Structural Division
873-J Alcoa Building
Pittsburgh 19,
Pennsylvania

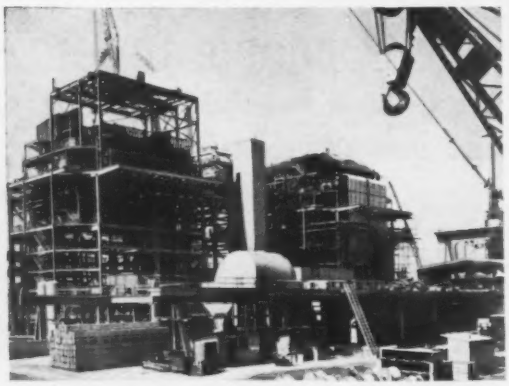
ALCOA ALUMINUM

STRUCTURAL DIVISION

For exciting drama watch "Alcoa Presents" every Tuesday evening—ABC TV



COMPLETE SERVICES FROM STUDY TO START UP



In all major fields of power generation—hydroelectric, conventional steam and nuclear—clients find that Bechtel experience covers every project requirement.

Power facilities by the company aggregate generating capacity in excess of 12,000,000 kilowatts. Individual projects vary from units with modest ratings to major steam plants of more than 900,000 kilowatts capacity. Energy sources include coal, oil, gas, water power and atomic fission.

The first electric power derived from atomic energy was generated at the A.E.C. Experimental Breeder Reactor built by Bechtel in 1949. Since then the company has had responsible roles in nuclear power study programs and as engineer-constructor of many important nuclear power plants.

Bechtel experience will interest utilities planning to build new generating plants or to expand existing facilities.

BECHTEL

BECHTEL CORPORATION

Engineers and Builders for Industry

SAN FRANCISCO • Los Angeles • New York • Houston

Canadian Bechtel Limited

TORONTO • Montreal • Calgary • Vancouver

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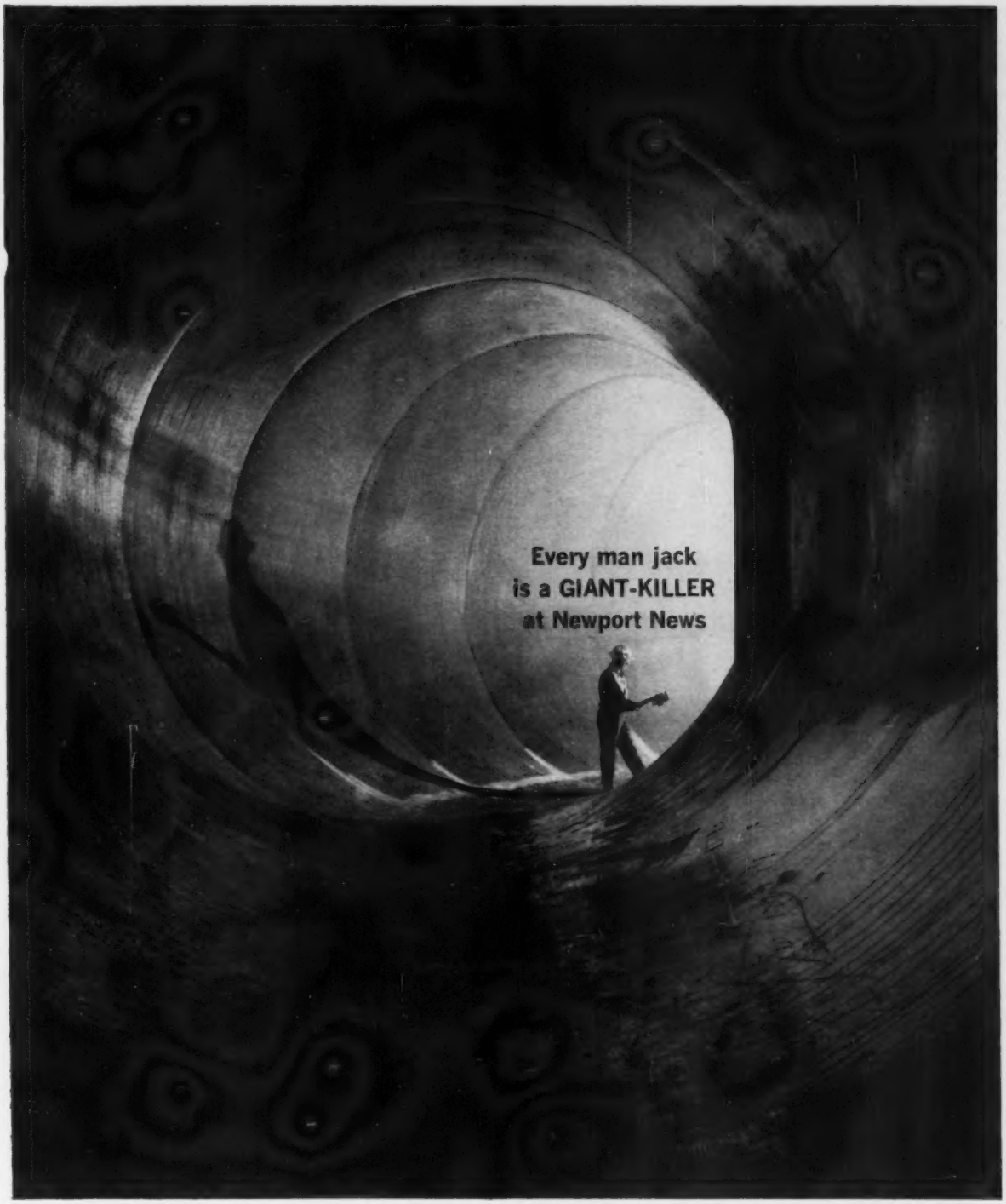


This huge hydraulic turbine casing dwarfs the workman—but to him and 15,000 others at Newport News, tremendous jobs such as this are routine.

Here giant engineering and production challenges are conquered in stride. Turbines, valves, gates and penstocks for the greatest hydroelectric projects—Niagara, Grand Coulee, Hoover and 96 others. Pressure vessels and similar heavy equipment for the petrochemical industry. Paper dryer rolls, wind tunnels, bridge caissons—almost any job that calls for heavy steel fabrication and machining of massive parts to close tolerances.

Whatever your project, call on Newport News. It has the men, methods and machines to accept the toughest challenge.

Newport News
SHIPBUILDING AND DRY DOCK COMPANY
NEWPORT NEWS, VIRGINIA

For phone number of closest representative see advertising index in back of book.

IN NEW Wagner®

LIVE BETTER ELECTRICALLY

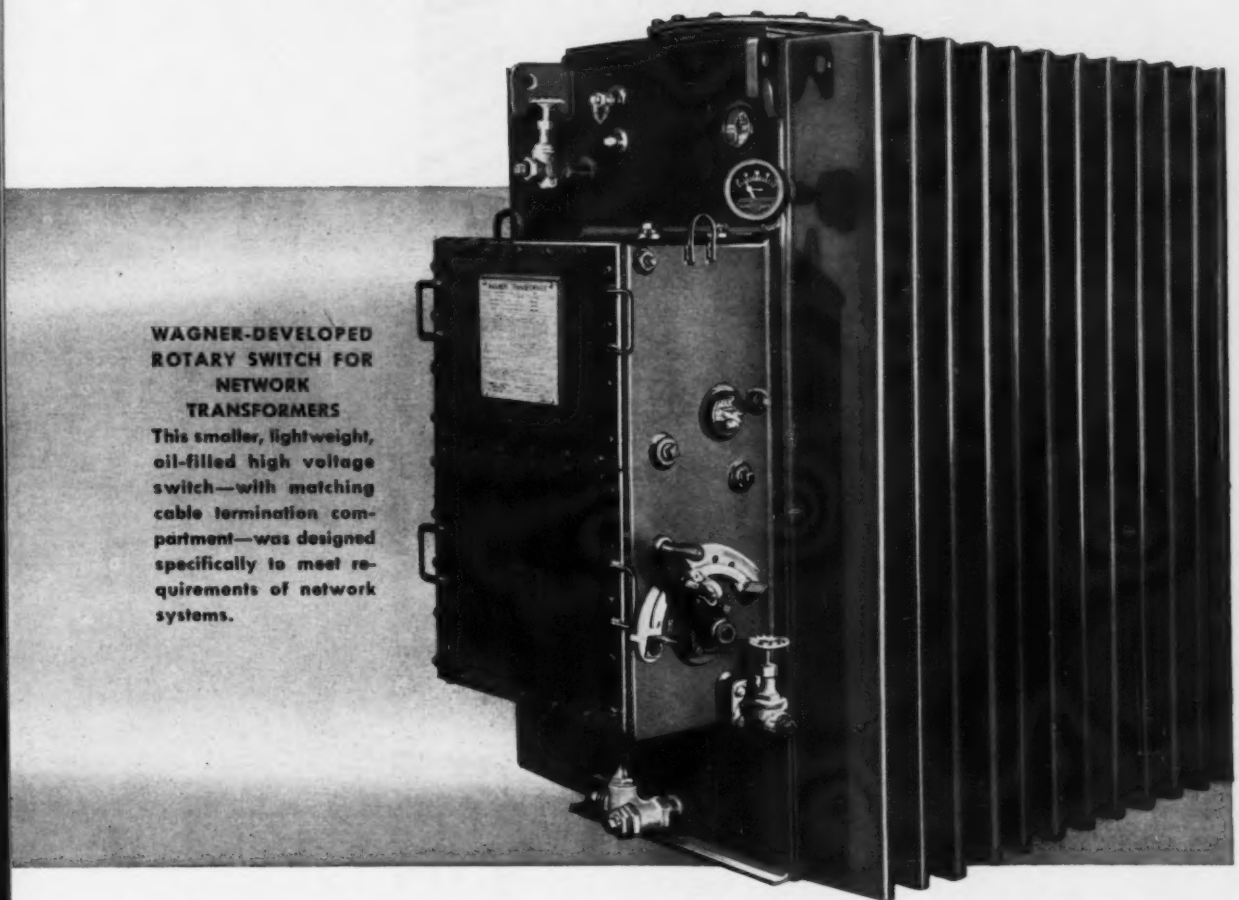
SIX 2000 KVA WAGNER NETWORK TRANSFORMERS installed on the system of Dallas Power and Light Company serve the Southland Center. The 42-story Southland Life Tower and the 600-room Sheraton-Dallas Hotel consume an enormous amount of power . . . power used, for example, by 15,800 lighting fixtures, 28 elevators, 8 escalators, an all-electric company cafeteria, and a 6,450 ton electrically-driven air conditioning system.

SERVING 2 GREAT GROWTH INDUSTRIES . . . ELECTRICAL . . . AUTOMOTIVE

NETWORK SYSTEMS... or OLD

Network Transformers

will fit in close quarters... are small in size... have compact rotary switch... modern, corrugated cooling surfaces



WAGNER-DEVELOPED ROTARY SWITCH FOR NETWORK TRANSFORMERS

This smaller, lightweight, oil-filled high voltage switch—with matching cable termination compartment—was designed specifically to meet requirements of network systems.

Wagner® Network Transformers are designed to give you smaller, lighter units, with smoother contours for easier maintenance. In new networks you can cut system costs by constructing smaller vaults to hold these space-saving transformers. In older systems you can put larger ratings in your present vaults. Maintenance costs are less, too. The corrugated radiators can be quickly cleaned from above, and an anti-corrosive tank finish protects exterior surfaces for years. A special undercoating on the base protects the transformer even under adverse conditions of underground installation.

CORRUGATED TANK-COOLING SURFACES eliminate dirt-catching corners. Radiating surfaces are easy to clean, and there are no hard-to-get-at spots to hinder painting when it's needed. Reliability is improved because there are fewer places for leaks to develop.

LOWER NOISE LEVEL has resulted from improvements in core design and materials, and newly developed methods of annealing the core steel. Lower noise levels are a feature of all Wagner transformers.

Over 65 years of constant research and development have made Wagner a leader in transformer design... made the Wagner name one of the foremost in power planning. For expert advice in solving your network transformer problems, consult your nearby Wagner Sales Engineer. There are Wagner branches in 32 principal cities.

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Wagner Electric Corporation

6381 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

WT61-7

For phone number of closest representative see advertising index in back of book.

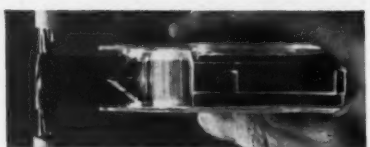
New from Johns-Manville!

Now! Tape...and tear...with one hand!

THIS BRAND-NEW DISPENSER makes handling plastic electrical tape a revelation! Far safer, too, because the cutter is permanently shielded . . . can't snag hands or clothes.

From beginning to end, you'll save time and trouble with J-M *Dutch Brand* Plastic Electrical Tape in this great new dispenser. And you'll like *all ten* of the big advantages shown on the right.

But, see for yourself! Get all the facts on Dutch Brand® Plastic Electrical Tape in the handy new dispenser from your J-M Dutch Brand Distributor. Or write to Dutch Brand Division, Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ont. Cable: Johnmanvil.

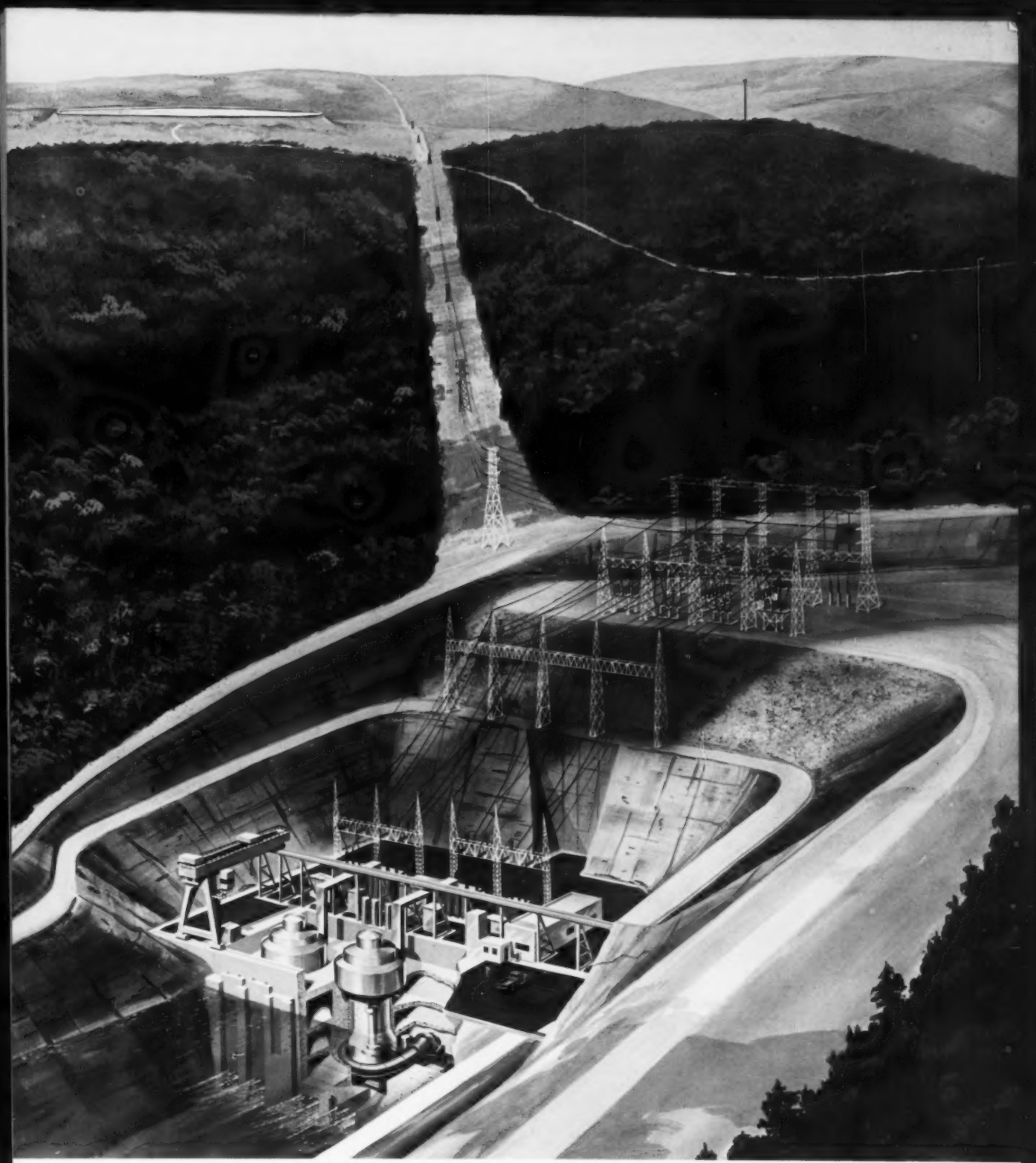


TEN IMPORTANT ADVANTAGES!

1. *Permanently shielded cutter!* 2. *No moving parts to snag hands, clothes!* 3. *Can't dull or clog!* 4. *"Tape-and-tear" with one hand!* 5. *Special "grip-strip" for faster starting!* 6. *Full 66' of finest plastic electrical tape made!* 7. *Preloaded . . . ready to go!* 8. *Protects tape against dirt, grease!* 9. *Big center hole for easy handling!* 10. COSTS NO MORE THAN TAPE ALONE!

JOHNS-MANVILLE
DUTCH BRAND ELECTRICAL TAPE

JOHNS-MANVILLE JM PRODUCTS



TAUM SAUK

Union Electric Co. • St. Louis, Mo.

Pumped-Storage Project to have the two largest-capacity hydro units ever built. Total capability of these reversible pump-turbines is more than 600,000 HP under 800 ft. head. This—first in pure regeneration—is another example of Allis-Chalmers product leadership. *Write Hydraulic Division, York, Pa. for additional information.*

ALLIS-CHALMERS

ANACONDA WIRE & CABLE IS MADE IN THE WEST TO FIT THE NEEDS OF THE WEST

FROM ORANGE, CALIFORNIA MILL . . .

A full line of wire and cable is ready to go to work for utilities, contractors, electrical manufacturers — all of Western Industry.

Fast, efficient service directly to you, from nearly 100 Western Anaconda Distributors . . .

FROM REDWOOD CITY, CALIFORNIA MILL . . .

A wide range of highly specialized products meets the exacting needs of the electronics and missile industries. This new Anaconda facility, formerly the Sequoia Wire & Cable Company, rounds out Anaconda's complete wire and cable service to the West.

Call the Man from Anaconda at Sales Offices in Denver, Los Angeles, San Francisco or Seattle. Or see your local Anaconda Distributor. 61371

ASK THE MAN FROM
ANACONDA®
COPPER AND ALUMINUM WIRE AND CABLE

For phone number of closest representative see advertising index in back of book.

Sunshine City

This is Tucson, Arizona, where the skies are azure and the sunshine sparkles day after day, all year round.

This is Tucson whose exciting past is filled with Spanish missionaries, Indians and cowboys . . . and which now boasts a university, an electronics industry, an air base, and myriad other assets . . . all set amid surroundings perfect for work or play.

Famous Supima cotton is grown in the same valley. Dude and cattle ranches abound. Mexico lies only 65 miles to the South.

Little wonder Tucson has grown from 262nd to 54th in rank among U.S. cities in the past ten years.

Tucson lies athwart the main line of one of the nation's leading railroads . . . and is served by the Tucson Gas, Electric Light, and Power Co., a fast-growing modern utility whose offices are circled in the photo above.

And supplying the needs of both utility and industrial users is Kerite Cable.

KERITE CABLE

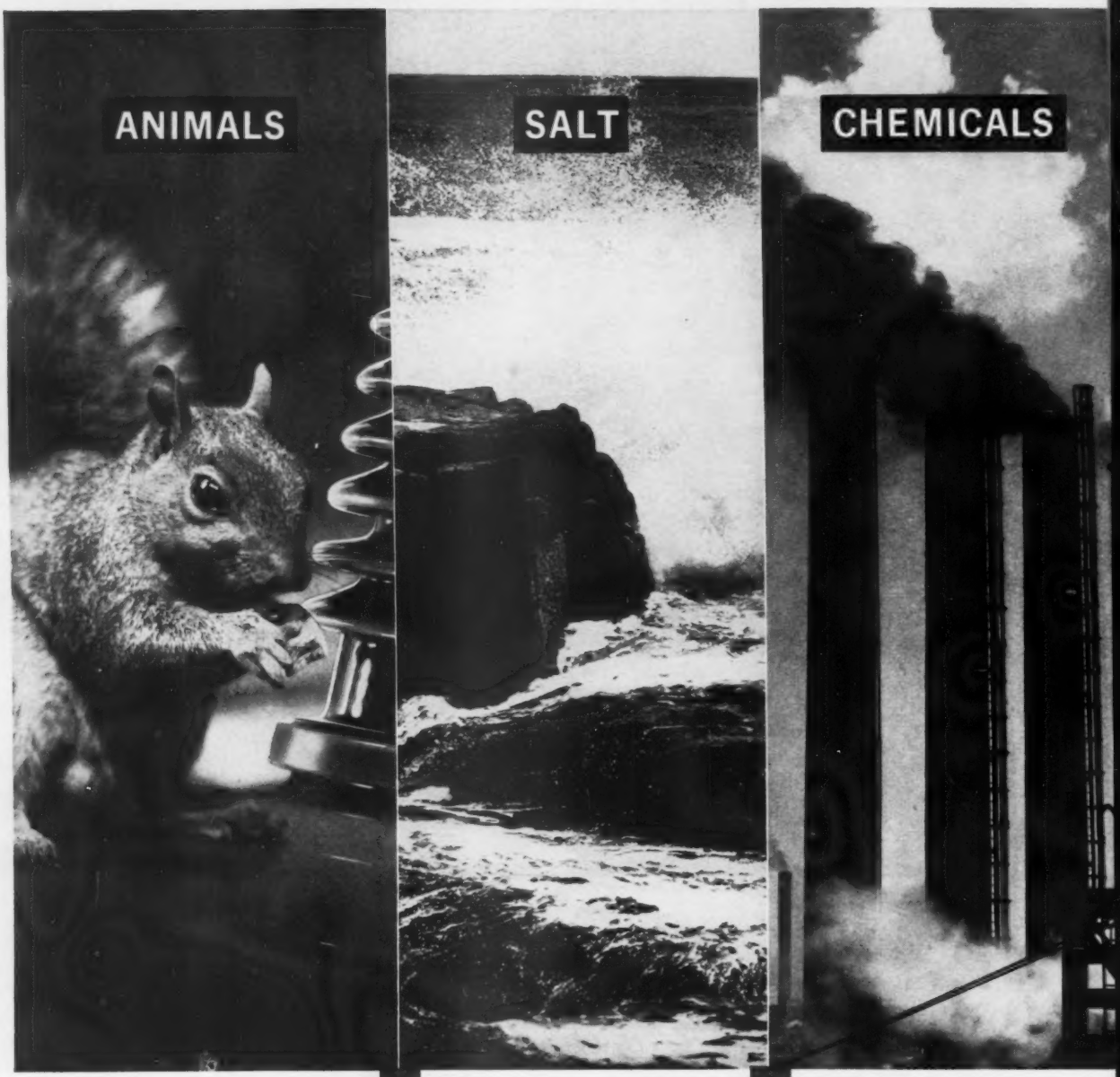
it's the **KERITE** *that makes the difference*

General Office—30 Church Street, New York 7, N. Y.

SALES OFFICES:
Albuquerque, Ardmore, Pa., Birmingham, Boston, Chicago, Cleveland, Denver, Glendale, Cal., Houston, Lake Wales, Fla., Oakland, Portland, Ore., St. Louis, Salt Lake City, Seattle, Tallahassee, Tampa

For phone number of closest representative see advertising index in back of book.

ARMORTEC STANDS UP TO

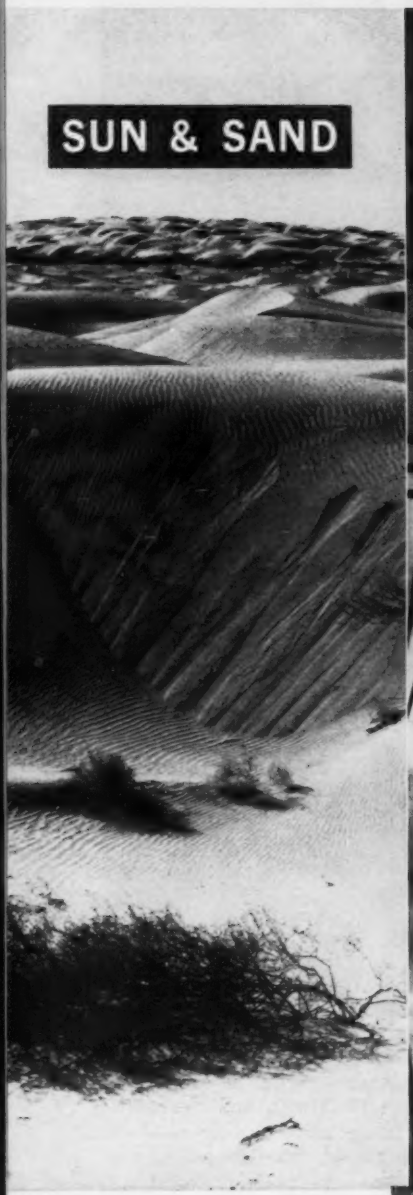


ARMORTEC eliminates outages due to birds and animals. Applied up to six times thicker than conventional paint coatings. Provides 22,000 volts insulation on the transformer cover and cover band.

ARMORTEC coating is uniform. Sharp edges and corners fully protected. Armortec leaves no room for rust and corrosion from salt spray . . . 10,000 hours of salt spray test had no effect.

ARMORTEC is pure vinyl. Caustics from industrial smokestacks can't hurt it. Armortec is corrosion-proof . . . over 6,000 hours of weatherometer exposure proved it.

COSTLY TRANSFORMER ENEMIES!



ARMORTEC is unaffected by sunlight. Won't blister, peel, chalk, or craze. Armortec is abrasion resistant. It has the resiliency of rubber, shrugs off driving sand . . . verified by actual sand blast demonstrations.

ARMORTEC is tough. It can take rough handling. Armortec can't be chipped off because it's fused to the metal. Grueling impact testing proved Armortec 100 times superior to conventional paint.

Check how much Armortec will save you!

Trouble Source	Your Costs for Transformer Repair and Replacement
Birds and animals	$.....
Corroding salt spray	$.....
Industrial fumes	$.....
Sun and windblown sand	$.....
Transportation and installation handling	$.....
TOTAL	$.....

Armortec stands up to these costly transformer enemies . . . Protects transformers like no other coating.

Armortec is not paint. It is pure vinyl plastic. It is fusion-bonded to the entire exterior transformer surface: the tank, cover and band. It is tough, resilient, indestructible. Armortec protects your transformer investment from everything under the sun!

Save transformer repair and replacement dollars with Armortec. Standard on all R T & E pole-type transformers . . .

AT NO ADDITIONAL PRICE

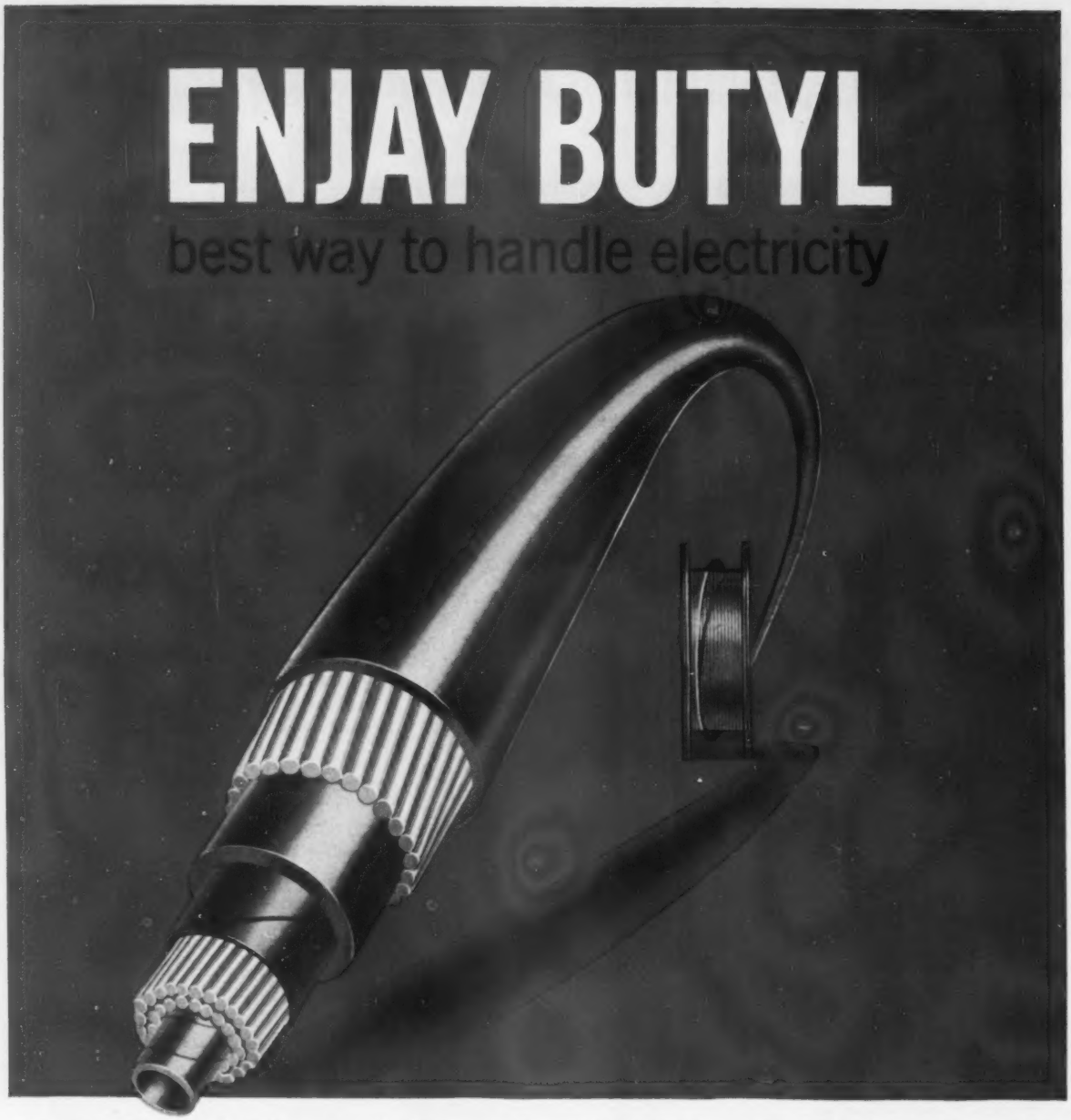
RT&E CORPORATION

Waukesha, Wisconsin
Portland, Oregon
Arlington, Texas

For phone number of closest representative see advertising index in back of book.

ENJAY BUTYL

best way to handle electricity



Enjay Butyl withstands all the common foes of electrical insulation — heat, water, corona, ozone, sun, weather, and high-voltage discharge. Because of its exceptional heat resistance, Butyl-insulated cable lets you carry a higher current with a given conductor size. Water absorption of Butyl insulation at 90°C is only about one-sixth that of conventional compounds, making it ideal for underground and underwater applications.

Butyl's high dielectric strength prevents excessive loss (with its resultant cable deterioration and increase in transmission cost); also guards against breakdowns due to surge currents. These characteristics have made Enjay Butyl the preferred rubber for insulation of power cable, transformers and bus bars. Coupled with outstanding abrasion resistance, these same characteristics point the way toward increased use of Butyl as a jacketing material.

For more information, write to Enjay, 15 West 51st Street, New York 19, New York.

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

ENJAY® BUTYL

On ENGINEERING evaluation Lapp Hi-F rates as sound "functional design"

"In engineering, we don't think there's much more sense to over-design than there is in under-design. We rate as "most efficient" that transmission line design that comes closest to matching up the strength characteristics of conductor, structure, hardware and insulators.

"Most of our transmission system is designed for a working load of only a few thousand pounds. Lapp **Hi-F**, *with an M&E strength rating of 14,000 lbs., is an up-to-date 'compact model' suspension insulator. Because it satisfies our engineering requirements, and saves the company money, it goes on our standards list pronto!"*

There's no compromise with quality in Lapp **Hi-F**—only a reduction in size and weight (and a more realistic relationship between rated strength values and actual performance characteristics). As compared with the NEMA standard 10" suspension insulator, Lapp **Hi-F** is 1" smaller in diameter, one-third less in weight, and is fully interchangeable physically. Rated at 14,000 lbs. M&E strength, **Hi-F** matches EEI-NEMA-52-3 in every other mechanical rating, and in every electrical characteristic. On every consideration, technical or economic, we think you too will rate Lapp **Hi-F** as "OK."

Lapp Insulator Co., Inc., LeRoy, N. Y.

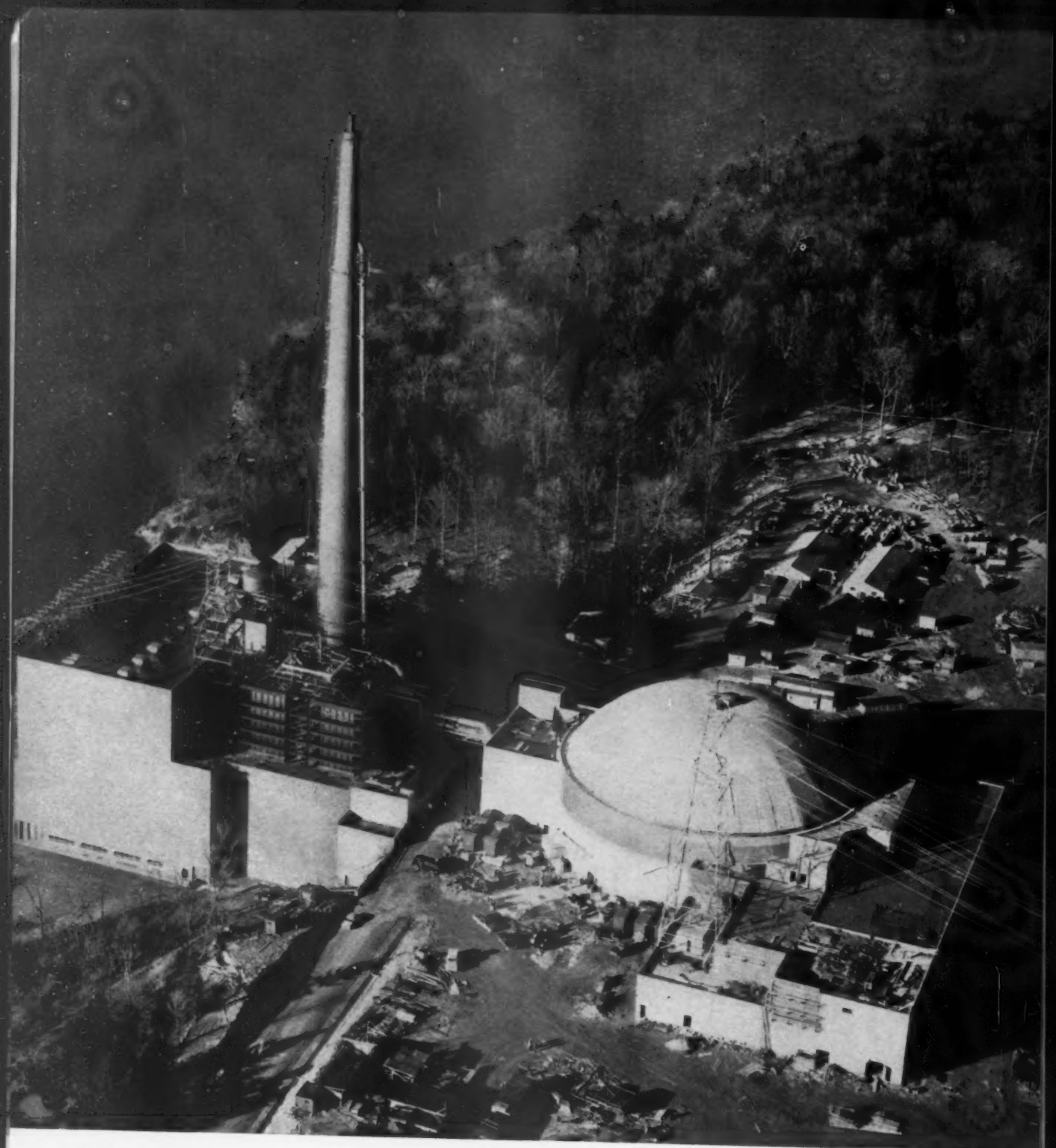
For phone number of closest representative see advertising index in back of book.

Nuclear propulsion...

Babcock & Wilcox

Nuclear testing...

Babcock & Wilcox



Nuclear power generation...

Babcock & Wilcox

Broad experience makes B&W a nuclear leader

In every phase of nuclear activity, Babcock & Wilcox is making important contributions. Three examples:

1. *Nuclear propulsion.* B&W designed and built the nuclear reactor for the N.S. Savannah's 22,500 shaft horsepower plant. The world's first nuclear-powered passenger-cargo ship, the Savannah will travel 350,000 miles without refueling.

2. *Nuclear testing.* B&W is designer of the nuclear portion of the nation's largest test reactor. The Advanced Test Reactor, to be located at National Reactor Testing Station in Idaho, will operate at 250,000 kw (thermal).

3. *Nuclear power generation.* B&W designed and built the reactor for Con Edison's 275,000 kw (electrical) Indian Point station. Now nearing completion, Indian Point will mark the first large scale use of thoria-urania fuel.

These projects are typical of the many things B&W is doing in the nuclear field. The Babcock & Wilcox Company, 161 E. 42 St., N.Y. 17, N.Y.

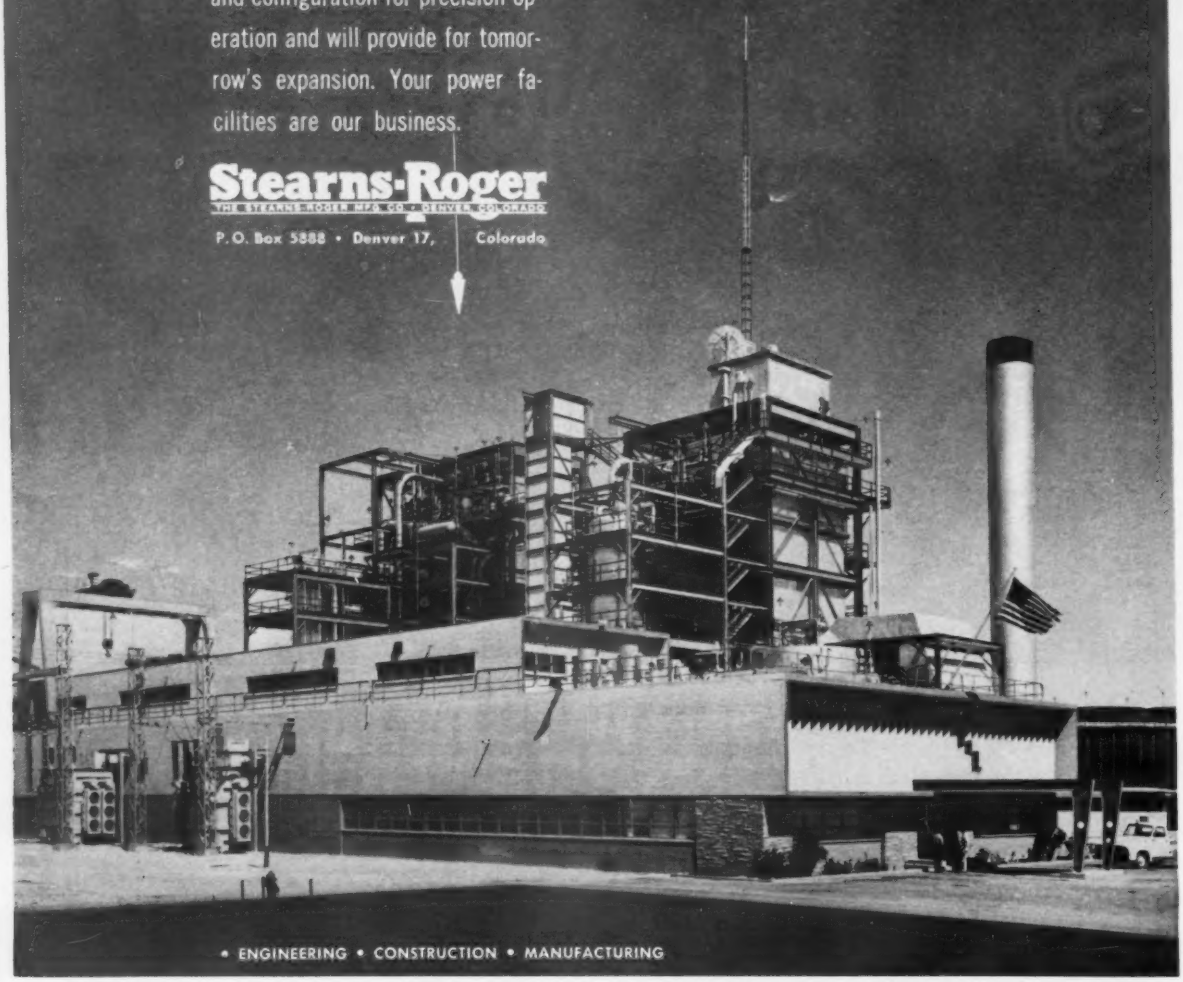
Babcock & Wilcox

PUT THESE IN YOUR POWER PICTURE:

YESTERDAY'S EXPERIENCE.....
TODAY'S PRACTICE.....
TOMORROW'S PERFORMANCE...

Power plants by Stearns-Roger contain 75 years of engineering-construction background and the best of today's design concepts. With our help you can meet tomorrow's power requirements efficiently and economically. Your plant will incorporate equipment and configuration for precision operation and will provide for tomorrow's expansion. Your power facilities are our business.

Stearns-Roger
THE STEARNS-ROGER MFG. CO. • DENVER, COLORADO
P. O. Box 5888 • Denver 17, Colorado



• ENGINEERING • CONSTRUCTION • MANUFACTURING

For phone number of closest representative see advertising index in back of book.

New! SPANG BLUE STAR CONDUIT

Now—from SPANG comes a new improved galvanized rigid steel conduit. Here's what it offers you:

NEW—*best thread protection available against rust*

. . . a smooth, uniform zinc galvanized coating on every ridge and valley of every thread . . . easy coupling—can be hand tightened the whole way . . . no thread chasing . . . no excess zinc . . . Preece-tested to assure quality and dependability.

NEW—*double galvanized coating on the conduit for extra corrosion resistance*

. . . inhibits white rust formation . . . eliminates flaking of finish . . . has that fine SPANGLEAM appearance.

NEW—*better packaging for easier handling*

. . . bundled in steel strapping in sizes up through 2" . . . shipped on a one-ton rectangular lift for convenient transit by lift truck...cuts handling costs—makes inventory easier.

* * *

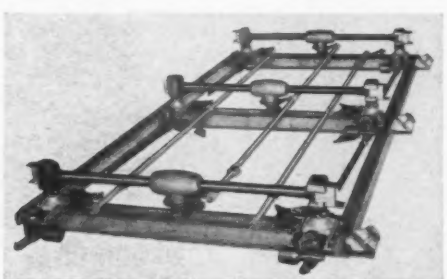
Save installation time, get top protection against rust and corrosion with new SPANG Blue Star Galvanized Rigid Steel Conduit. See your nearby SPANG Distributor for complete details and samples.

SPANG Blue Star Conduit is one of the many fine products produced by *National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Penna.*

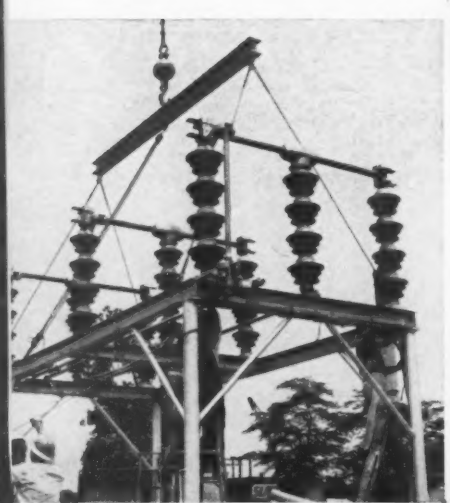
ARMCO National Supply Division

For phone number of closest representative see advertising index in back of book.

Above is a partial view of the Ravenswood Substation showing some of the switches in place on the aluminum stands. In all, there are 54 disconnect switch structures as well as a variety of structures for bus supports, lightning arresters, coupling capacitors and wave traps, cable potheads, and potential transformers.



Preassembled welded aluminum switch structure as it arrived from the factory. Switch bases are integral with frame. Grounding switches and their interphase rods were also factory installed in many cases.



The photograph at left shows the special sling used to lift the switch package into position on the leg sections. The columns for a typical stand were installed in approximately 10 minutes; insulators were installed in a little over an hour, and the switch lifted and bolted into position in less than 15 minutes.

RAVENSWOOD GOING UP...

A NEW CONCEPT IN SUBSTATION DESIGN AND CONSTRUCTION

Ravenswood transmission substation which serves Con Edison's big new generating plant along the East River in Long Island City, New York, is going up smoothly and quickly. One of the major factors contributing to the speed and ease of its erection is a bold new concept in substation design and construction: factory preassembly of switch structures.

The original idea for these packaged structures came about as a need voiced by Con Edison's engineers. Working with them on the project, Southern States' Structural Engineering Department conceived a practical design permitting much assembly work normally accomplished in the field to be done at the factory.

Ravenswood, the world's largest aluminum transmission substation, was the first practical application for this concept. When construction started, these compact, easily handled units were in the field ready for installation. They consisted of completely assembled welded aluminum frames with integral switch bases, interphase rods, and components of the switch mounted in position. By simply removing the switch live parts and reassembling with insulators, the packaged structures, with switches already adjusted, were ready for installation. In addition, factory fabricated aluminum stands further reduced the number of hours required to get a switch installed.

Some of the advantages of this approach are readily apparent. Contrast the handling required for these factory assembled switch structures to the conventional method of shipping all pole units separately. Further, in usual practice, all interphase rods, clevises, adjustable arms, grounding shunts, and numerous nuts and bolts are unassembled when they arrive at the job site. As construction engineers will confirm, a lot of valuable time is spent sorting and preparing such switches for mounting. And once the switches are in place on their stands, interphase rods have to be installed and the switch completely adjusted for proper opening and closing. (The packaged units require only a minor adjustment of tilting rings after the switch is installed.)

According to Con Edison, savings at Ravenswood are significant.

Although the use of aluminum structures and aluminum stands as employed on this station may not be practical in some areas and for some utilities, the principle involved may represent a real breakthrough in substation construction. For example, the basic idea could be easily applied with factory assembled, bolted steel sections for mounting on any type of stand whether aluminum, steel column, or conventional structure.

With labor costs skyrocketing, serious consideration should be given to the practicability of factory preassembly of switch structures for your next substation.

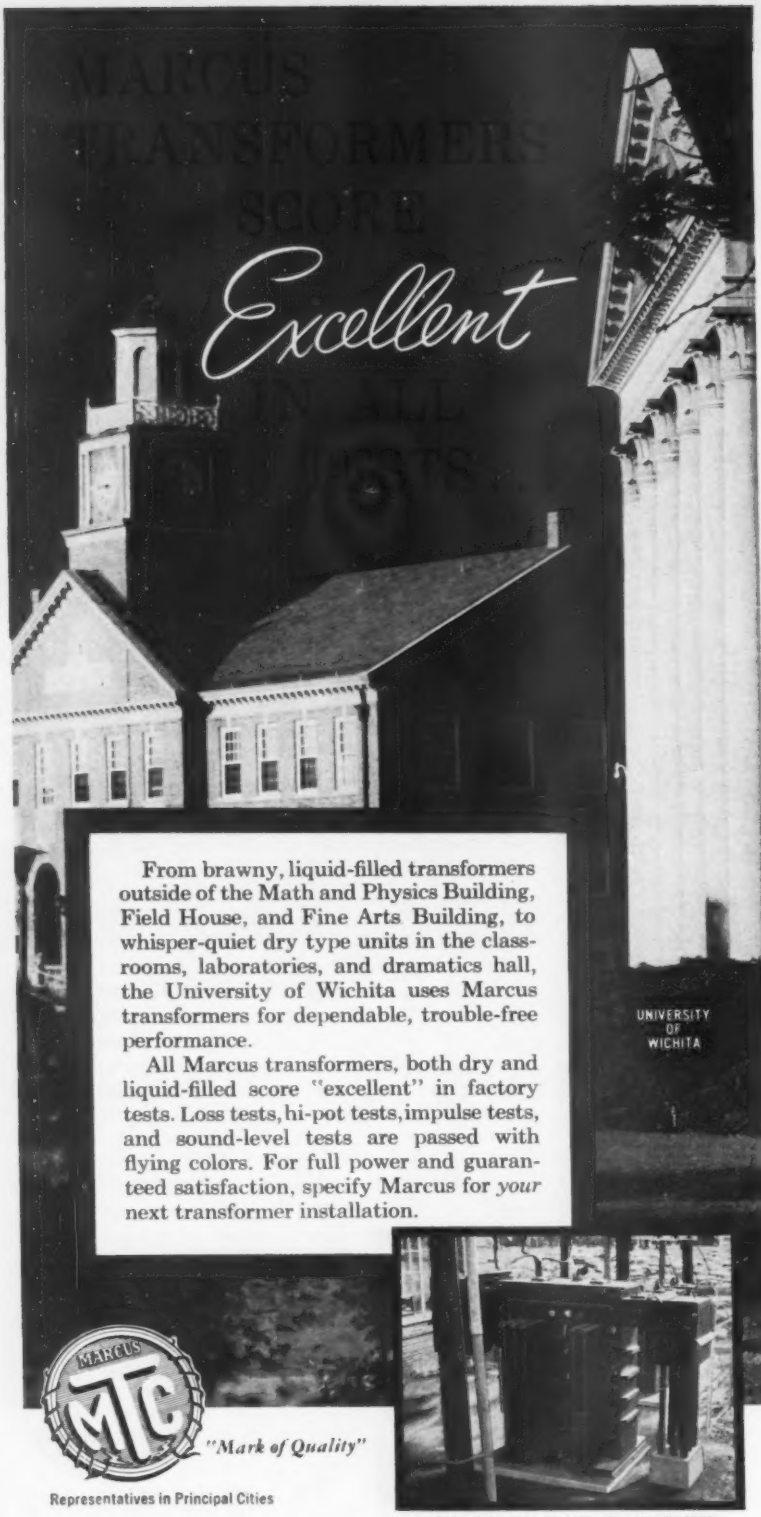
Why not discuss this new idea with your Southern States representative or contact us direct for additional information?

SOUTHERN STATES

HAMPTON, GEORGIA

IN CANADA: DOMINION CUTOUT CO., LTD., TORONTO

For phone number of closest representative see advertising index in back of book.



From brawny, liquid-filled transformers outside of the Math and Physics Building, Field House, and Fine Arts Building, to whisper-quiet dry type units in the classrooms, laboratories, and dramatics hall, the University of Wichita uses Marcus transformers for dependable, trouble-free performance.

All Marcus transformers, both dry and liquid-filled score "excellent" in factory tests. Loss tests, hi-pot tests, impulse tests, and sound-level tests are passed with flying colors. For full power and guaranteed satisfaction, specify Marcus for *your* next transformer installation.

MARCUS MTC "Mark of Quality"

Representatives in Principal Cities

1500 KVA OIL FILLED TRANSFORMER

MARCUS TRANSFORMER CO., Inc.

RAHWAY, NEW JERSEY

A COMPLETE LINE OF DRY TYPE AND LIQUID-FILLED TRANSFORMERS THRU 5000 KVA

Meetings Calendar

SEPTEMBER

6-8—*Northwest Public Power Assn.*, Power Use Section, annual meeting, Pacific University Campus, Forest Grove, Ore.

10-13—*Rocky Mountain Electrical League*, annual convention, Jackson Lodge, Wyo.

11-13—*International Association of Electrical Inspectors*, Northwestern Section, Owyhee Hotel, Boise, Idaho.

17-20—*National Association of Electrical Distributors*, Western regional conference, Jack Tar Hotel, San Francisco.

17-21—*IAEI*, Southwestern Section, Lafayette Hotel, Long Beach.

20-21—*Electric Companies Public Information Program*, workshop conference, Brown Palace Hotel, Denver, Colo.

20-22—*Northwest Electric Light & Power Assn.*, 54th annual meeting, Sheraton-Portland Hotel, Portland.

25-27—*Joint ASME/AIEE National Power Conference*, St. Francis Hotel, San Francisco.

28—*Bureau of Home Appliances*, fall conference, Balboa Park, San Diego.

OCTOBER

3-5—*Electric League of Southern California*, Lighting Progress Exposition, Palladium, Hollywood, Calif.

5-6—*Northwest Public Power Assn.*, Accounting and Finance Section, annual meeting, Everett, Wash.

16-18—*Northwest Electric Light & Power Assn.*, Business Development Section, Davenport Hotel, Spokane.

26-27—*Pacific Coast Electrical Assn.*, Hawaiian conference, Princess Kaiulani Hotel, Honolulu.

NOVEMBER

6—*American Institute of Electrical Engineers*, Los Angeles Section, third Western technical conference, Biltmore Hotel, Los Angeles.

24-29—*Electrical & Home Appliance Show*, Balboa Park, San Diego.

27-28—*Pacific Coast Electrical Assn.*, Administrative Services Section, fall conference, Miramar Hotel, Santa Barbara, Calif.

JANUARY 1962

14-19—*Los Angeles Winter Market.*

22-26—*San Francisco Market*, Western Merchandise Mart.

FEBRUARY

26-27—*Pacific Coast Electrical Assn.*, Business Development Section, Huntington-Sheraton Hotel, Pasadena, Calif.

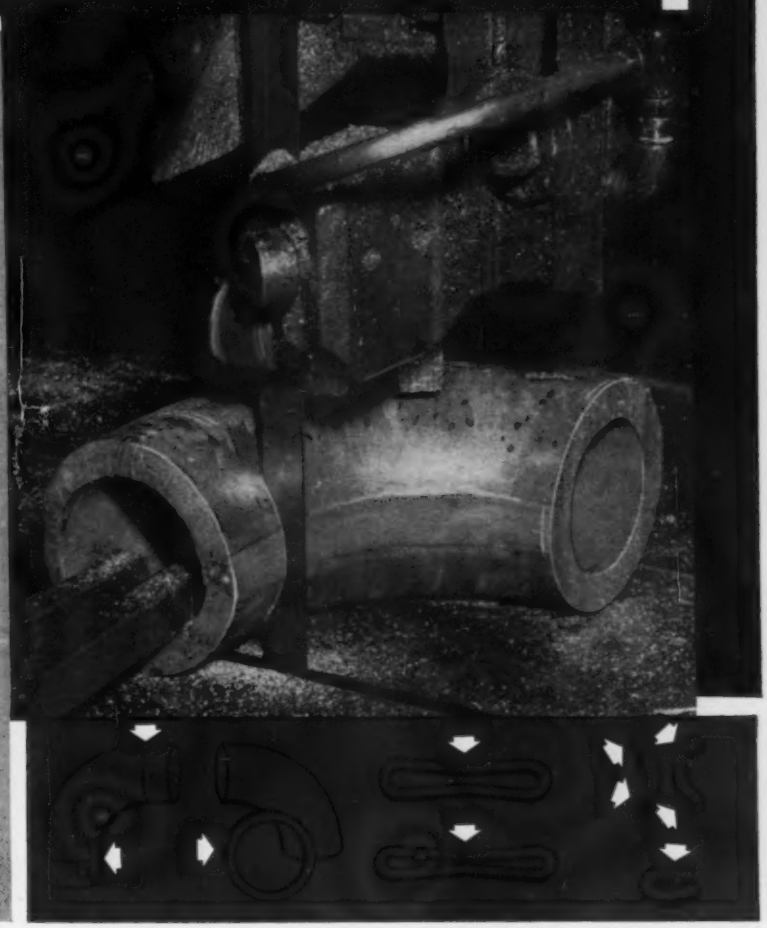
MARCH

22-23—*Pacific Coast Electrical Assn.*, Engineering & Operating Section, Sheraton-Palace Hotel, San Francisco.

26-27—*PCEA*, Administrative Services Section, spring conference, Villa Hotel, San Mateo, Calif.

Extra Length of fitting used for testing purposes

NO EXPENSIVE DUPLICATES NEEDED for destructive tests on MIDWEST nuclear fittings



1. Fitting is made with extra long tangents.
2. Tangents are cut off both ends.
3. One of the resulting rings is flattened in a press, in accordance with specifications, and closely examined for possible defects.
4. For welded-type fittings a section of the other ring, including weld, is bent back upon itself, and inspected for evidence of fissuring or other discontinuities.

Midwest's unique method of obtaining specimens for destructive tests assures an extremely accurate and dependable basis for testing . . . without manufacturing expensive representative samples! Tension tests, corrosion tests, and photomicrographic studies are also performed on tangents cut from the finished fitting assuring dependability beyond comparison.

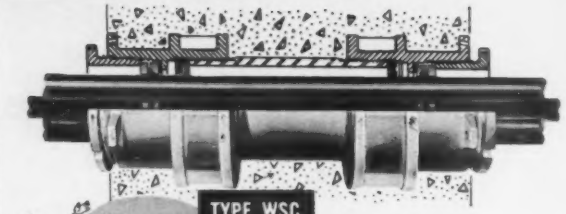
Write for new brochure: Critical Piping for the Nuclear Age

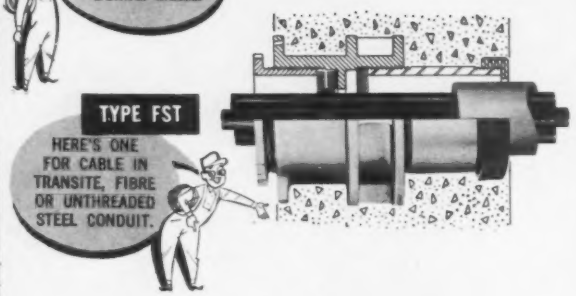
MIDWEST PIPING A DIVISION OF CRANE CO.
1450 S. SECOND ST. • ST. LOUIS, MISSOURI

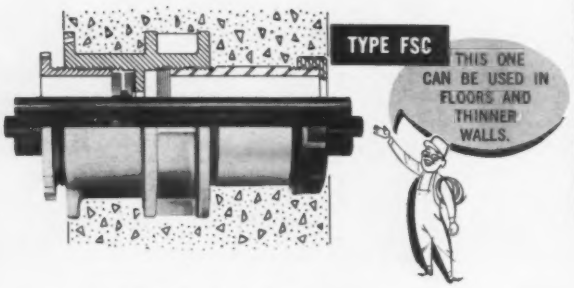
6008

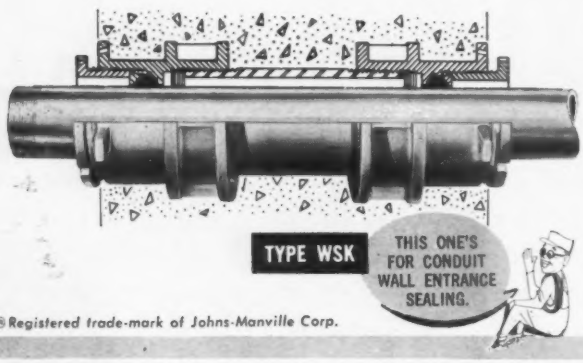
For phone number of closest representative see advertising index in back of book.

NEW! a complete line of O.Z. WATERTIGHT ENTRANCE FITTINGS for Conduit or Cable

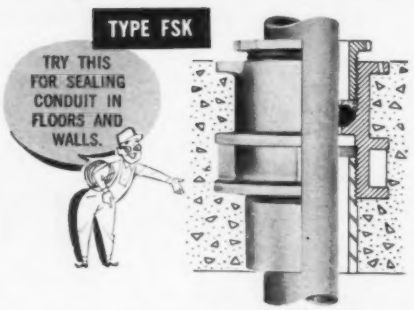








End leakage problems once and for all! O.Z.'s new wall and floor entrance fittings for installation in concrete provide a positively watertight seal around conduit or cable at any pass-through point! Use them with threaded or unthreaded steel conduit, fibre or Transite® conduit, or exposed cables of varying number and sizes. Gland-type sealing assemblies, with pressure bushings, may be tightened at any time. Fittings accommodate conduit ranging from ¾" to 6". Standard types, sizes available from stock. Specials made to order.



For more information on fittings and other O.Z. products, call your local distributor, or write to the company.

® Registered trade-mark of Johns-Manville Corp.

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O.Z. ELECTRICAL MANUFACTURING CO., INC.
262 BOND STREET • BROOKLYN 17, N. Y.

- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

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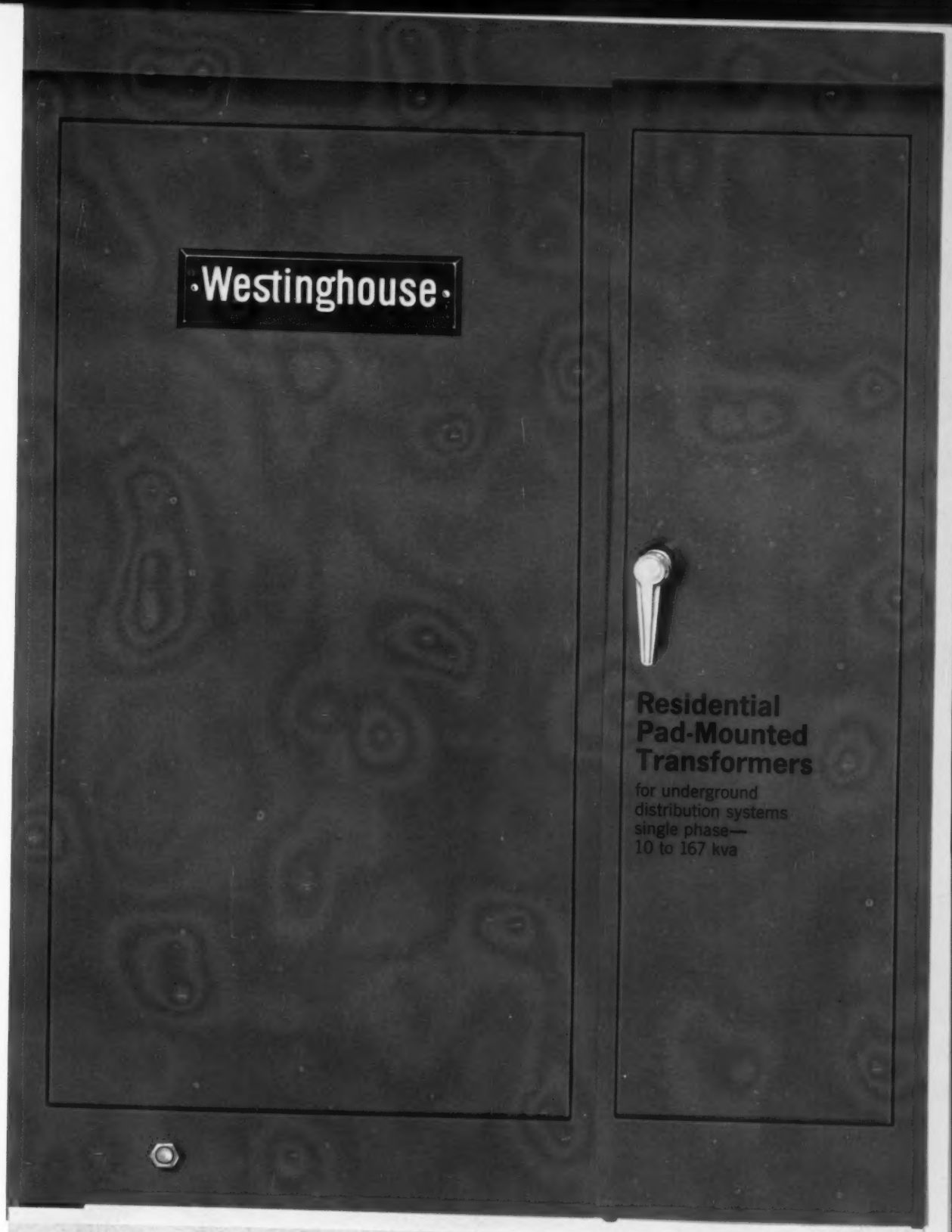
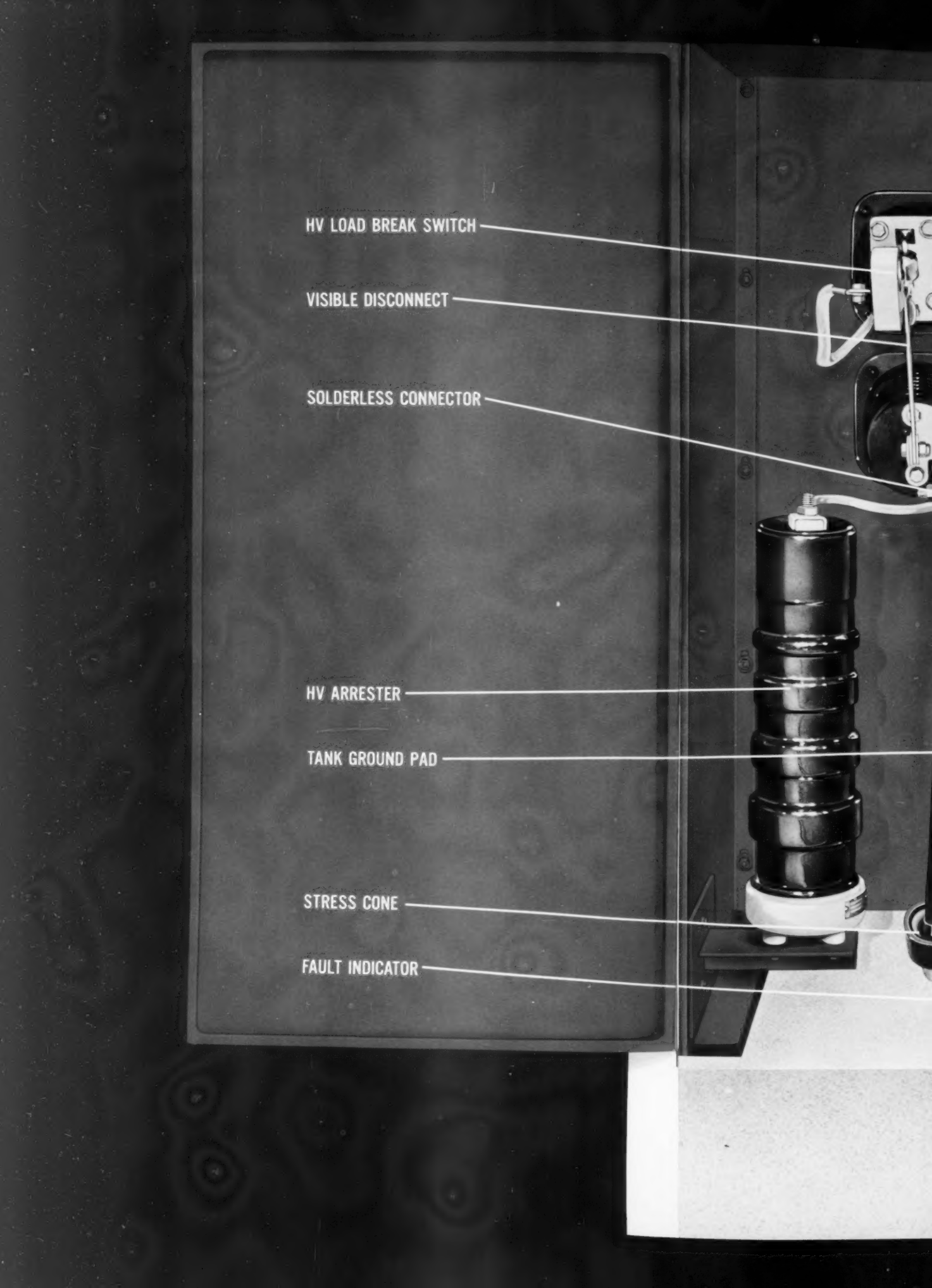
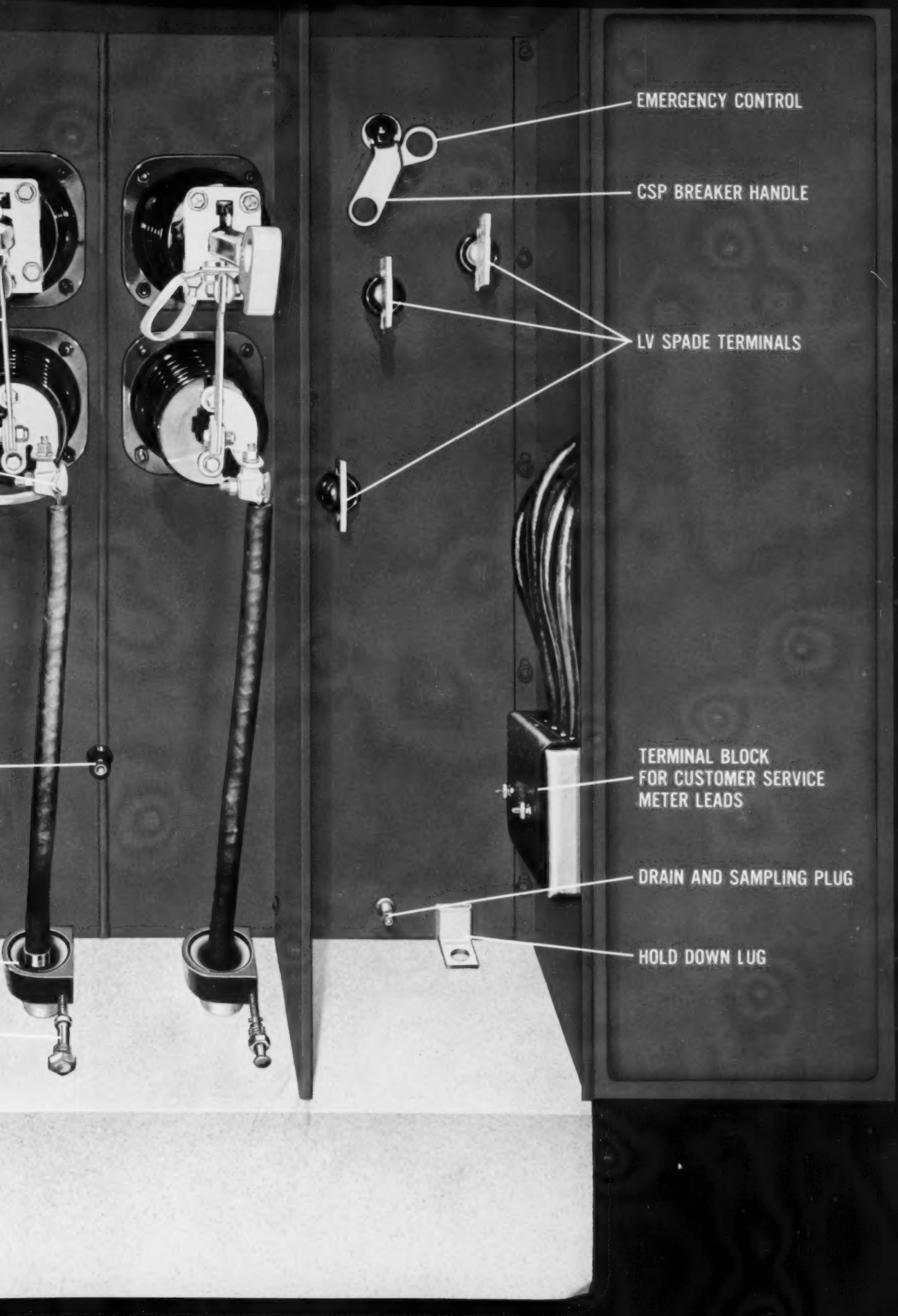
Office and Warehouse: 665 So. Van Ness Avenue, San Francisco 10, Calif. • GArfield 1-7846


·Westinghouse·
Residential
Pad-Mounted
Transformers
for underground
distribution systems
single phase—
10 to 167 kva


HV LOAD BREAK SWITCH
VISIBLE DISCONNECT
SOLDERLESS CONNECTOR
HV ARRESTER
TANK GROUND PAD
STRESS CONE
FAULT INDICATOR


EMERGENCY CONTROL
CSP BREAKER HANDLE
LV SPADE TERMINALS
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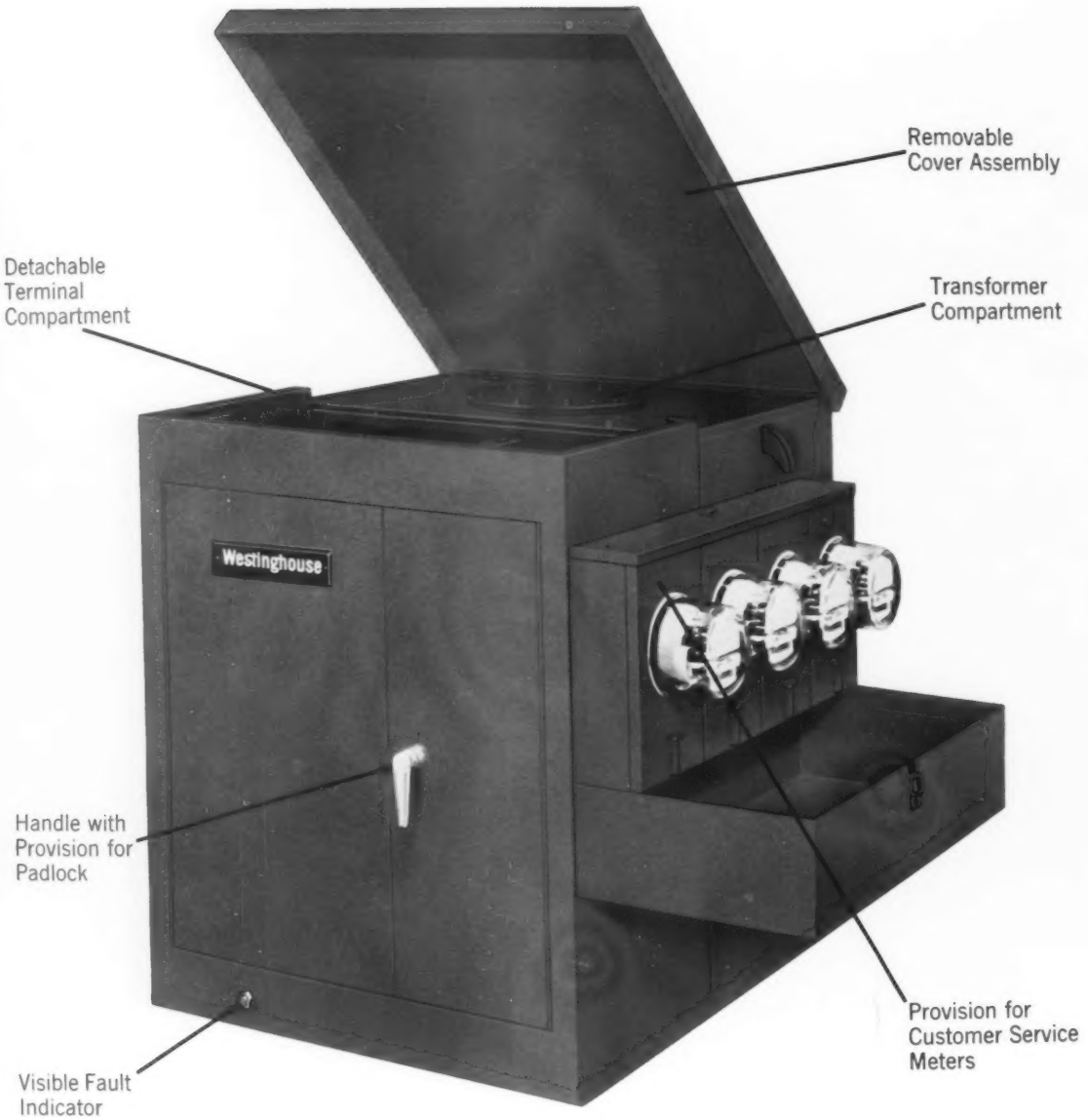
METER LEADS
DRAIN AND SAMPLING PLUG
HOLD DOWN LUG



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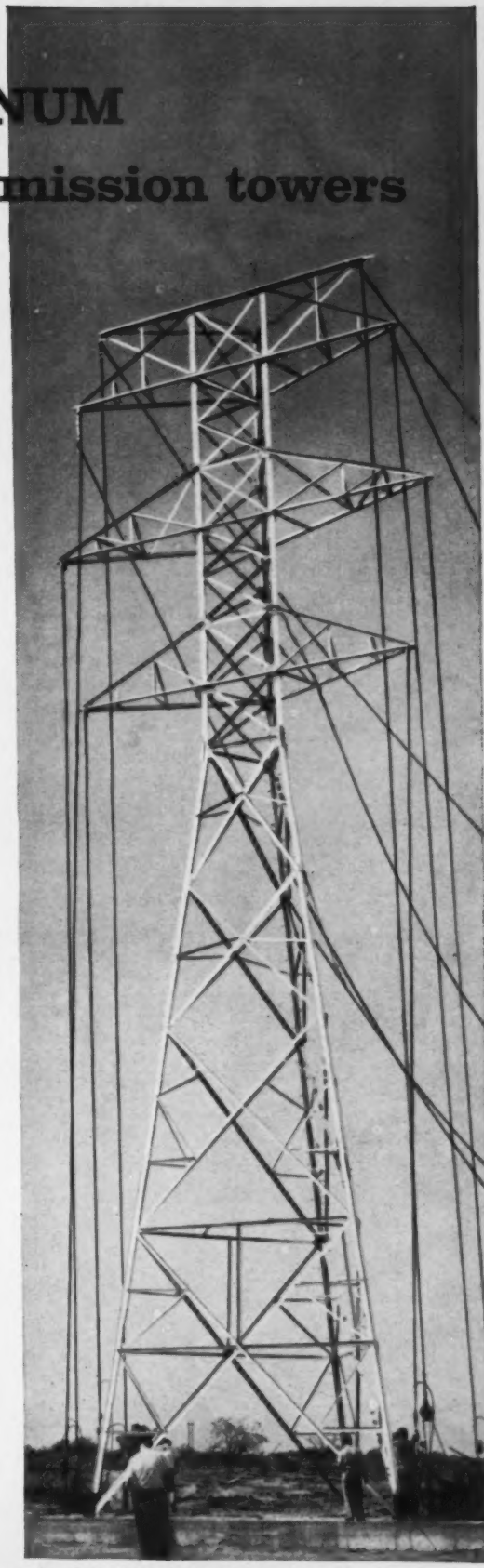
to cut your costs



At Phoenix, Arizona, Reynolds Structural Fabricating Division is designing, fabricating and assembling new aluminum towers. Because aluminum is light in weight, fabrication and assembly are simplified. Because aluminum combines strength with light weight, structure weight can be reduced 60 to 70% while retaining load-carrying capacities of structures made of heavier metals. And these lighter weight structures naturally cost less to ship, cost less to erect. (Helicopters can even be used to transport lightweight aluminum structures into otherwise inaccessible areas.)

Towers built of aluminum require only minimum maintenance because aluminum is corrosion resistant and cannot rust, ever. It is an ideal material for structures located in seacoast areas or industrial atmospheres. In contrast to aluminum, periodic protective painting on towers made of other metals can very easily, over a period of years, cost more than the original tower! Also with aluminum, there's no problem of painting "hot" towers or the costly practice of stopping transmission service for maintenance.

Reynolds can offer a complete series of standard aluminum structural shapes or design new shapes to fit your requirements. New types of transmission towers are constantly being designed, fabricated and tested at Reynolds Structural Fabricating Division in Phoenix.

Add up aluminum's advantages in fabrication, assembly, erection and maintenance. The result: transmission towers that will deliver longer service at a lower per year cost. For complete information, call your nearest Reynolds Sales Office or write *Reynolds Metals Company, P. O. Box 2346-EK, Richmond 18, Virginia.*

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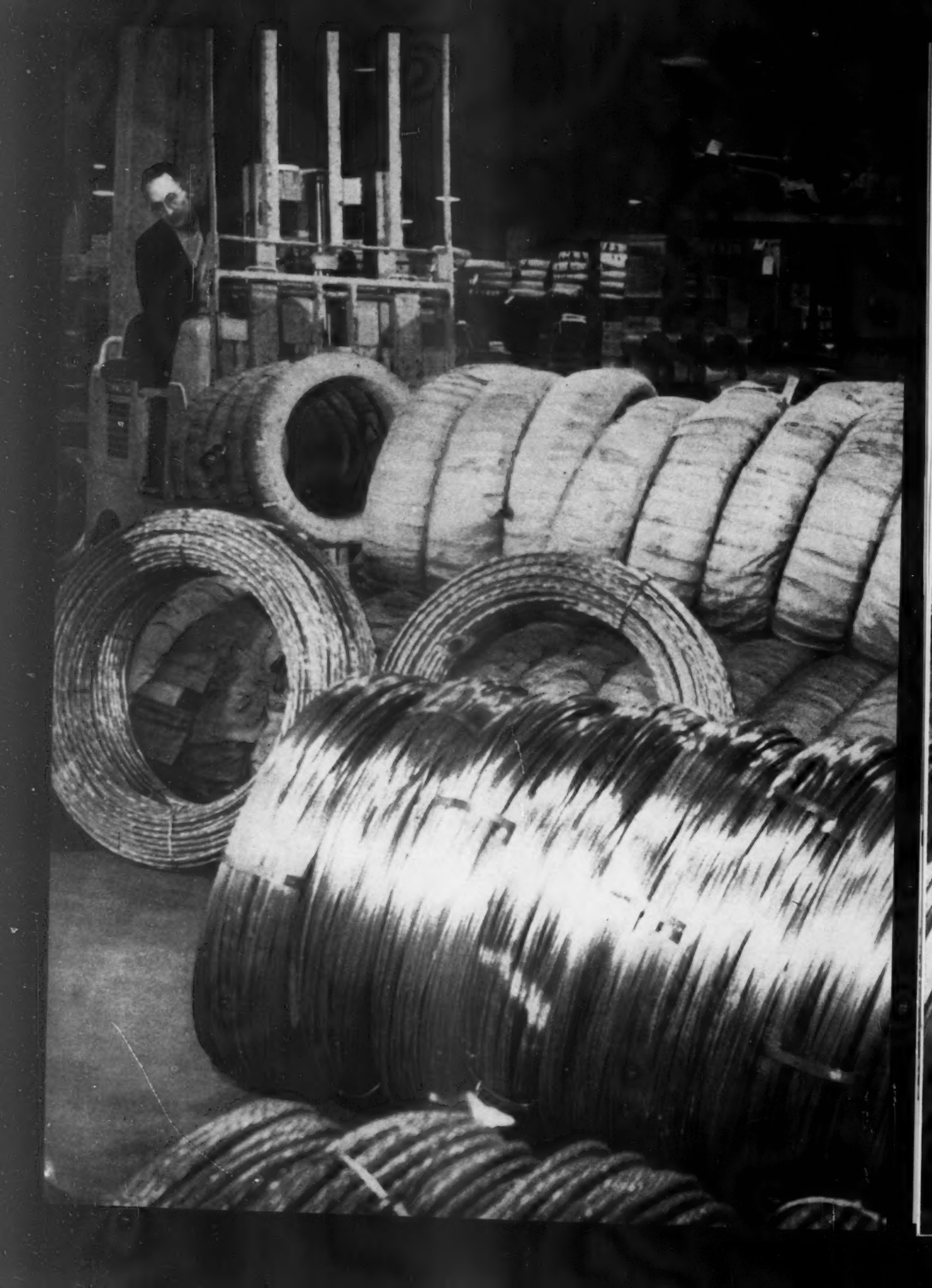
For phone number of closest representative see advertising index in back of book.



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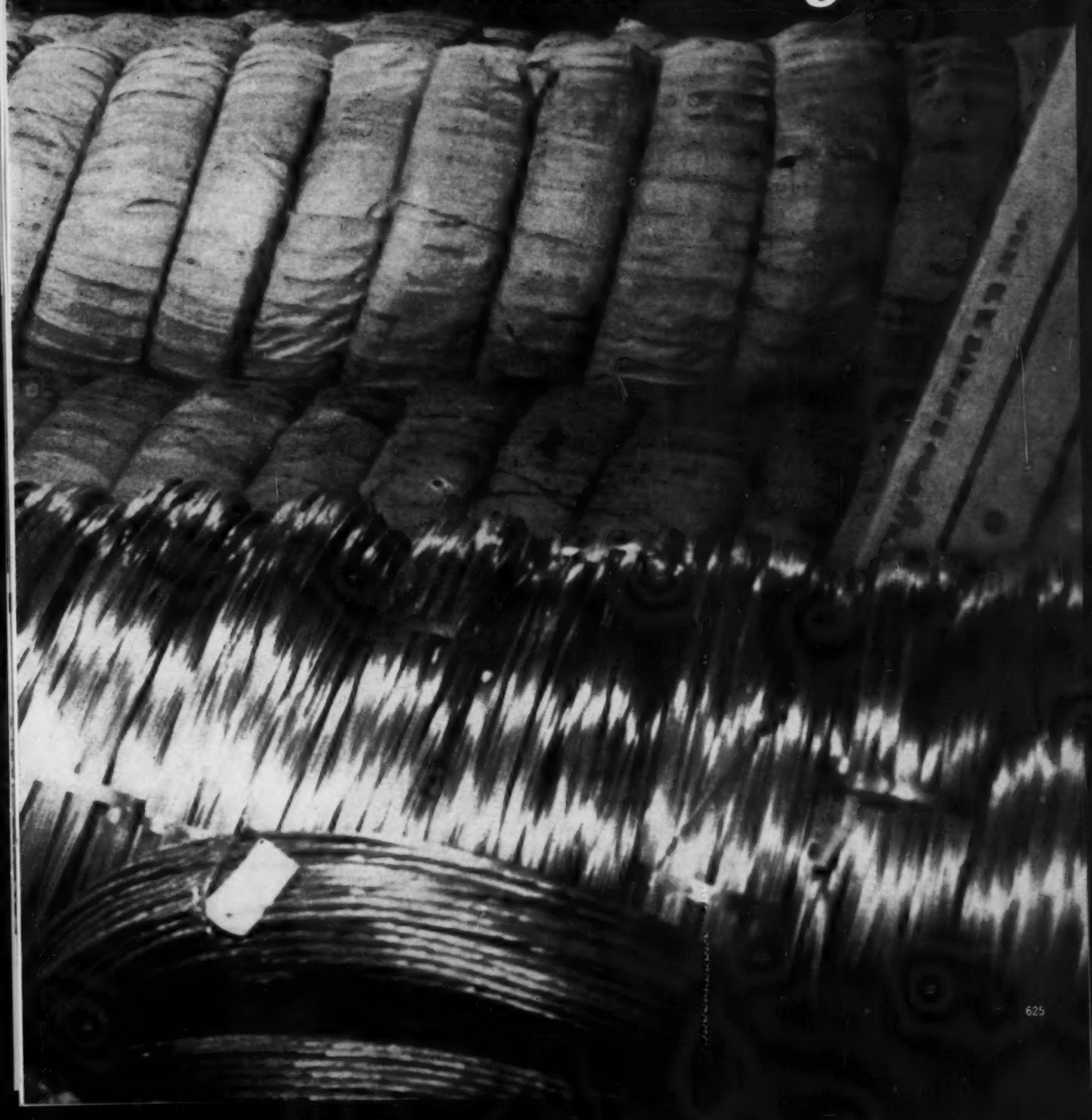

625

NEWS

Edited for the electrical industry of the West

No Decision Yet On B. C. Power Corp.

While the future of B. C. Power Corp. still hangs in the balance, A. Bruce Robertson, appointed president following government seizure of B. C. Electric (EWEST News Letter, August), has said that he will try to get greater compensation for stockholders. Formerly senior vice president of B. C. Electric, Robertson said losses in the takeover run into millions.

If B. C. Power accepts the suggested pegged price for its remaining shares, common shares, frozen at $34.25, will rise to $38, government valuation. The company's stock went to an all-time high of $53 in 1958. In 1960 its high was $37.50, low $33.25.

If B. C. Power sells all its shares to the government it will receive $178 million (it has already received about $111 million) and hand over all assets, excepting its name. It could then reinvest in other activities or go into voluntary liquidation. Under the latter plan, the shareholders would pay liquidation costs from their $38 selling price.

B. C. Power still owns 50% of International Power & Engineering Corp., Western Development & Power Ltd., which in turn owns 20% of Peace River Power Development Co., and other assets.

Observers in B. C. have stated their belief that federal-provincial agreement on the Columbia development will be further away as the result of government acquisition of the Peace River project. Premier Bennett's move in seizing BCE is seen as a political one based on (1) the utility taxation picture; (2) increasing pressure to reach agreement with Ottawa on the U. S./Canadian treaty for Columbia development; and (3) the Peace River power problem. While the provincial government has denied it is in any way delaying Columbia development, Peace River has been a government fostered project.

A political opportunist, Premier Bennett is basically a conservative but does not follow any party line, it is stated. His takeover of B. C. Electric is seen as a means of stealing the thunder and some votes from the Socialist party which has long advocated public power as well as giving the provincial government a big club to swing at Ottawa over corporation tax sharing agreements. Immediate start on the Peace will help develop the northern part of the province and further Bennett's ambitions in that direction. It also gives him control of most of the major electric power generation and distribution in the province. (It has been stated that West Kootenay Power & Light and East Kootenay Power will be taken over shortly.)

The takeover has boosted British Columbia's indirect debt by $700 million to an all-time high of $1.3 billion.

► **An Advisory Council on Nuclear Energy and Radiation** has been appointed by Washington's Gov. Albert Rosellini, in accordance with a bill passed by the 1961 state legislature. Members are Paul J. Raver, superintendent of Seattle City Light; W. E. Johnson, general manager of Hanford Works for General Electric; Joseph L. McCarthy, dean of the graduate school, University of Washington; Dr. Milo Harris, Spokane; Donald A. Hicks, chief of applied physics section, Boeing Airplane Co., Seattle; David Williams, secretary of Hanford Atomic Trades Council, Richland; and Dr. S. Town Stephenson, dean of faculty, Washington State University, Pullman.

►Two Waterville, Wash., attorneys who previously served as legal counsel for the Douglas County PUD have filed a **$42,000 lawsuit against the district** for legal fees. Ned Kimball and C. M. Clark were discharged as PUD attorneys last November after a change in the membership of the PUD board of commissioners. Kimball and Clark allege in their suit that they performed services for the PUD from Feb. 1, 1959, to Nov. 30, 1960, "for the reasonable value of $75,000." In their complaint they said they were paid $33,000.

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Montana Drops REA Work

Montana's Water Conservation Board has announced that it will eliminate its REA department after 25 years of operation. State Engineer Fred Buck said the board would discharge its REA force of seven persons on Oct. 1, in keeping with an informal suggestion from the legislative committee.

Alec McDermott, the board's assistant secretary, said the move was made "because the REA managers let us down" after other interests complained the activity competed with private business. He stated that during the 1961 legislative sessions the REA managers met in Helena, were advised the water board was criticized for its REA activity and decided not to defend the proposed appropriation for the department.

McDermott charged that former Budget Director Jack F. Reid "vividly called legislative attention" to the REA department when he upped the item proposed for administration of the Helena office from $8,000 to $44,273 annually. He said that over the years the department had been cut from 50 to seven employees and existed simply to provide services usually not available from private engineering companies.

Legislative committees, however, had frequently urged state withdrawal from this type of service.

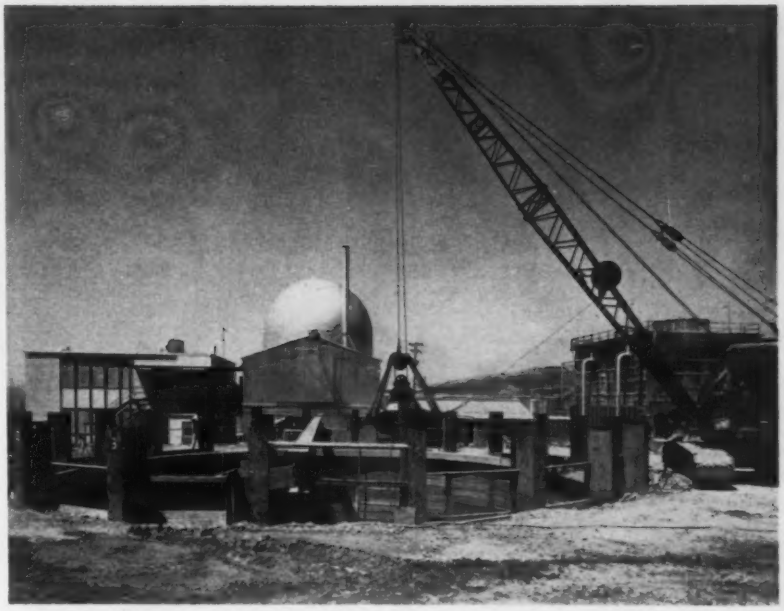
Boundary Bond Issue

Construction of Boundary Dam on the Pend Oreille River in northeastern Washington is certain to require Seattle City Light's largest bond issue, perhaps as much as $100 million.

Decision has yet to be reached as to whether all financing should be handled in a single issue or whether to raise money as work progresses. The municipal utility will await a recommendation from Ford, Bacon & Davis of New York, its financial consultant.

Regardless of the decision, the issue is certain to be larger than the $28 million issue of 1952 for completion of 360,000-kw Ross power plant and the $28,850,000 bond issue of 1951 for purchase of Puget Sound Power & Light Co.'s competing distribution system.

Construction of Boundary Dam and its 540,000-kw underground power plant is estimated to cost $97



EXCAVATION has been completed for the $8 million ESADA experimental superheat reactor at G-E's Vallecitos Atomic Laboratory in Pleasanton, Calif. The hole in the foreground, 48 ft in diameter, is for the hemispherical containment building that will house the reactor. The steel containment shell will be 128 ft high, extending 65 ft below ground. Immediately behind the excavation is the atomic power plant complex, including control building, turbine building and reactor containment

million but additional funds may be required to construct a 90-mile transmission line to Spokane. The Bonneville Power Administration is willing to wheel power over its lines 300 miles from Spokane to Seattle but has made no agreement on the Spokane-Boundary line.

The utility's FPC license calls for submission of design plans in six months, with construction expected to start next spring and be completed in 1967.

Judge Rules in Tacoma Case

The suit seeking to establish Tacoma's right to construct hydroelectric dams on the Cowlitz River may include a hearing on an injunction calling for the removal of existing construction, as the result of a decision by Judge Frank Hale in Pierce County Superior Court.

Judge Hale ruled that two Tacoma sportsmen have a right to intervene in the case, on the grounds that the Declaratory Judgment Act, under which the city is proceeding in its legal action, gives any city taxpayer an unconditional right to intervene in the case on his own behalf.

The sportsmen ask that the work be halted on Mayfield Dam and that all obstructions be removed from the river. A diversion dam has routed the river through a tunnel and concrete work is expected to start soon. If the sportsmen ask for an injunction, city attorneys are certain to demand a multimillion-dollar bond to protect the city from potential damages.

►Seventeen Loveland, Colo., city employees pleaded guilty in Larimer County court **to charges of electric meter tampering and were fined $50 each.** The misdemeanor carried a penalty ranging from $50 to $300 fine and from 30 to 90 days in jail. All 17 signed confessions they altered electric meters in their homes to reduce municipal electricity bills. Among them was Thomas Patterson, superintendent of the Loveland municipal electric department. The 17 are continuing in their city jobs, although the city council is studying the situation.

Eugene May Annex Properties

Eugene Water & Electric Board has approved an evaluation study by Ford, Bacon & Davis of Pacific Power & Light Co. properties surrounding its system. Territory includes growing residential areas north of Eugene and Springfield and scattered farm and residential customers.

The growing high-load residential area was part of the package Springfield Utility Board twice proposed buying. (Last June Springfield voters rejected by a narrow margin a $3,100,000 financing bond issue.)

Volume Buying

Movement is afoot in Los Angeles toward pooled purchasing of common use items by several local public agencies.

Latest development in the program of combined buying is a major purchase of electric lamps from Southwest Electric Co.

The Los Angeles Board of Education said that its department would save some $8,000 by pooling its lamp purchase with Los Angeles County and other agencies. Cost of the lamps, to be supplied between October 1961 and September 1962, will amount to about $120,000.

Los Angeles County Purchasing has been spearheading a program wherein school districts, cities and other public entities could gain mutual price advantages through volume buying. In the long-range plan the city of Los Angeles and the Los Angeles Department of Water & Power would also participate in the program. However, there are a number of legal barriers to hurdle.

PUD Bond Issue Sold

Cowlitz County PUD has sold a $1,540,000 bond issue to a combination of four firms with an interest rate of 4.0066%. The bonds will be used to finance final costs of the Swift Creek hydro development on the Lewis River, a joint project with Pacific Power & Light Co.

Firms in the combine are A. C. Allyn & Co., Blyth & Co., William P. Harper & Son & Co. and McLean & Co. A lower bid with a lower net interest cost figure was rejected because of a heavy payout in the early years of the issue. The winning bid calls for an even payout each year for the next 46 years. It offers one of the lowest interest rates quoted for a hydro project since financing of Priest Rapids, PUD Manager Glen Hittle said.

► **Contracts for wage increases** averaging 4.4% have been signed by the Clark County PUD for its engineers, office workers and nonunion administrative employees. Annual costs of the wage boosts for 1,842 employees will be almost $50,000.

THIS SHORELINE borders the site for Hawaiian Electric Co.'s Kahe generating station, for which ground was broken in August. The first unit is scheduled for operation in March 1963 and the second will be on the line two years later, with combined capability of 82,500 kw. Although the station initially will burn oil, it eventually will have both conventional and atomic plants, according to company plans

PP&L Begins Coal Explorations

Pacific Power & Light Co. has begun coal explorations in the Squaw Basin area near Eden Ridge in southwest Oregon's Coos County, where the company has mining rights on coal deposits already mapped.

A core drilling rig of Joy Mfg. Inc., Pittsburgh, Pa., began field investigations late in July.

Garth Duell, geologist on Pacific Power's research department staff, said the company holds prospecting rights on some 1,800 acres of the basin. Old mining records show prospectors reported coal outcroppings there about 1900. It is cutover land that has heavy brush growth.

Similar geological explorations by Pacific Power on Eden Ridge in 1956 and 1957 mapped two veins of subbituminous coal. The company subsequently obtained mining rights on 5,000 acres in connection with its plans for a future steam-electric plant to serve southwest Oregon.

The Eden Ridge coal field is adjacent to the site of a proposed hydroelectric development on the South Fork Coquille River. The power company has a license application pending before the FPC for the two-dam $23 million project. The plant would develop 77,000 kw.

► **The Wyoming PSC has divided by arbitration** Fremont County territory claimed by both Pacific Power & Light Co. and Riverton Valley Electric Assn. PP&L will serve the towns of Riverton and Lander and some adjacent areas. RVEA will be granted service rights to the towns of Arapahoe, Pavillion, Morton, Fort Washakie. The order was expected to be used as a basis for settling other disputes in Wyoming areas that are in transition from rural to urban communities.

► Officials of Pacific Power & Light Co. and of Columbia Basin and Umatilla Electric Cooperatives are negotiating on **service area boundaries** in the **96,000-acre desert tract the State of Oregon has leased to the Boeing Co.** for space age testing facilities. Agreement would preclude settlement by the Oregon PUC under a 1961 legislative act banning duplication of utility services.

► **A 4.154% wage increase for 750 City Light employees,** retroactive to April 1, has been approved by the Seattle City Council. It will go to employees covered by agreement with the IBEW and compares with a 2% increase granted other city employees in the 1961 budget. It will average $24.36 a month.

Street Lighting Program

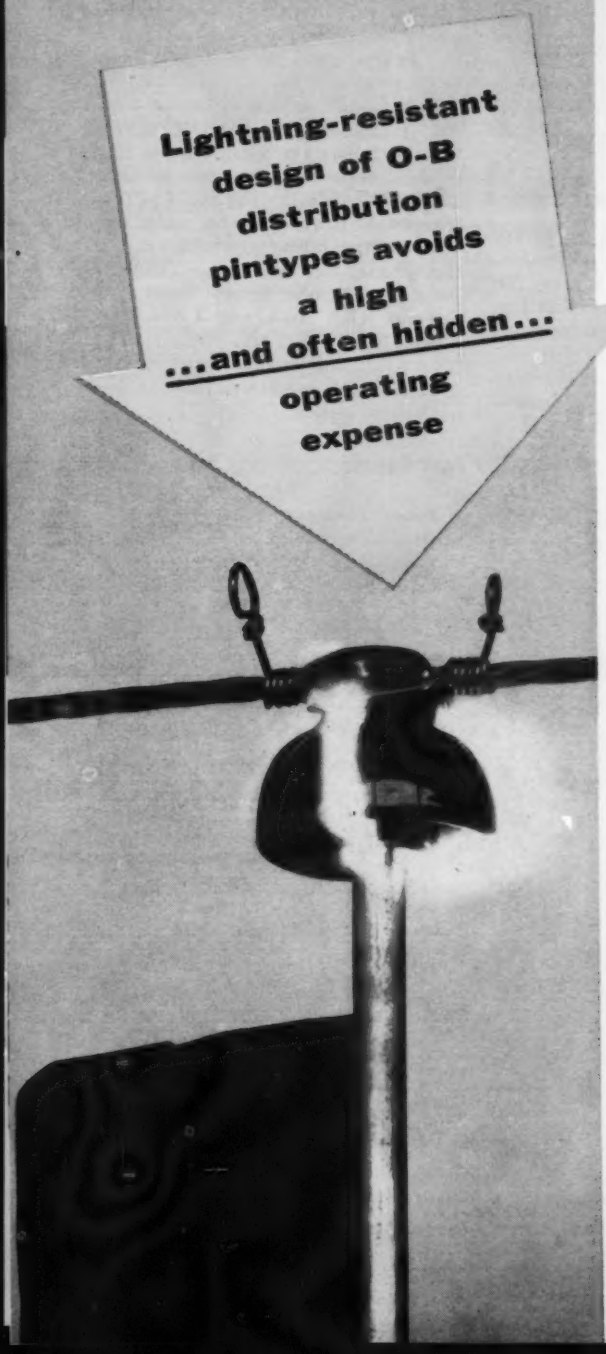
A majority of property owners in the 66-block downtown Denver area have signed petitions for a $2,000,000 street lighting improvement project. Property owners in the section would contribute $500,000. Public Service Co. of Colorado would pay $1,300,000 in installation costs and the city would finance $250,000 in traffic signal system modernization.

Perry G. Anderson, executive director of Denver Downtown Improvement Assn., said the street lighting improvement district would be the nation's largest. The program proposes placing 778 tapered poles, 32 ft high with 1,000-w mercury vapor lights, in the area over a three-year period. They would provide 10 times more light than the present system.

►**Average total labor cost for journeyman lineman** on public power systems of the Pacific Northwest for 1961 is $4.39 an hour, including nominal hourly rate of $3.51 plus 88c fringe benefits, according to the 15th annual wage survey conducted by the Northwest Public Power Assn. Last year the total cost was $4.22, including $3.37 hourly rate and 85¢ fringe benefits. The survey covers about 100 electric systems.

MODEL: Loren McKinley (left), director of the Oregon Museum of Science and Industry in Portland, and Frank Smith, Portland General Electric Co. engineer, inspect model of nuclear reactor donated to OMSI by Atomic Energy Commission and erected under supervision of Chad Peterson, PGE crew foreman (not shown). The model was part of the U. S. display at Brussels

The big profit is yours ...not ours



"I never heard of lightning damage to one of our distribution insulators."

That's just the point -- you **may not** hear about it. Sometimes it is not recognized by repair crews. Sometimes it is not reported. Other times, the information does not travel as far as the Purchasing Department. Lightning damage to insulators is relatively infrequent -- and you can be thankful for that!

Such an occurrence, however -- just one -- can amount to a substantial percentage of the total cost of a large quantity of pintype insulators. Any "bargain" in such insulators would be wiped-out many times over. See the explanation of lightning-puncture.

Fine technical facilities, competent manufacture, and a desire to make even small pintypes deserving of the company's reputation, account for the distinctive O-B property of lightning-immunity, at no premium in price. The big profit is **yours**, not ours!

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WHAT IS LIGHTNING PUNCTURE?

When the dielectric strength of an insulator is weaker than that of the surrounding air, a steep-front lightning stroke may go through it rather than around it. Sometimes this results in shattering the porcelain; the cause often being reported as "unknown." Other times it produces puncture with the insulator still intact.

A lightning-punctured insulator is very difficult to discover. The condition consists of a hair-like hole usually running from a point under the conductor or tie-wire to the end of the pin. Both ends of this microscopic hole are concealed. In dry weather the insulator will often sustain voltage. Only when wet is electrical leakage a certainty. This may exhibit itself as a cause for pole fires, as a public hazard due to a "hot pole", and almost certainly as a repeated source of service interruptions. Adding-up numerous trouble calls, difficulty of locating the damaged unit, and final cost of replacement, a single lightning-punctured insulator can become a major item of expense.

O-B has one of the few laboratories in the world that can produce electrical discharges even more violent than natural lightning -- and the ONLY pintype insulator, to our knowledge, that will consistently withstand these discharges. These facilities, and the willingness to apply them to the development of a low cost insulator, are unique in the industry. The difference you will discover in O-B pintype insulators is not in size, not in shape, not even in published price. The difference is in rugged performance -- in the ability to save you the trouble and high expense of lightning damage.

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10137-H

BEFORE AND AFTER photographs of one of Seattle City Light's major overhead clearing jobs, removal of excess wires and crossarms on Broadway and 10th Avenue East. More than 25 miles of wire and several hundred crossarms were removed, and height of poles on the two-mile stretch of street were reduced from 77 ft to 37 ft

Fish Ladders Help

Results of a study by the Portland District, U. S. Army Engineers, show that since installation of The Dalles Dam's carefully planned fish ladders an increasing number of spring chinook, fall chinook and steelhead salmon have been counted through McNary Dam upstream on the Columbia. Salmon move to upstream tributaries far from the ocean to spawn.

The raising of the pool behind The Dalles Dam at the end of the 1956 fishing season inundated Celilo Falls and Indian fishing sites. Both the easier ascent of the ladders as compared to the swift water of Celilo Falls and halting of Indian and commercial fishing have contributed to better salmon survival.

► **Operating properties** of major power and light companies in the State of Washington increased in value last year, according to the estimate of the State Tax Commission. Showing the greatest increase, Puget Sound Power & Light Co. was up $26,900,000 to a total of $172,300,000. Pacific Power & Light Co. was next, up $10,500,000 to $110,500,000, followed by Washington Water Power, up $2,700,000 to $62,700,000. Inland Power & Light showed an increase of $269,000 to $3½ million.

►**Rate reductions** have been announced by the Grant County PUD of Ephrata and the Clallam County PUD of Port Angeles. A new general service rate schedule in Grant County will save affected customers $60,000 a year. The PUD also has set a new industrial rate. Clallam PUD has lowered its commercial rates about 10% and also has created a lower rate to furnish one-cent electricity for electrically heated schools, halls and churches. The commercial reduction amounts to $22,000 a year.

►**Damages totaling $10,374.50** have been awarded in Los Angeles Superior Court to 26 persons employed at Advance Electric & Relay Co., Burbank on Aug. 5, 1955. On that date some 90 employees were hospitalized when gas fumes escaped from the air conditioning system and spread through the plant. The damages were awarded against D. L. Kissell Refrigeration Co., which had installed the equipment. Only 63 of the victims pressed suit and of these only 28 appeared in court to prosecute.

► **Bears in the rugged back country** of Lincoln County, Mont., are making things difficult for survey crews of the U. S. Army Corps of Engineers working at the site of the proposed Libby Dam on the Kootenai River. The bruins have been tearing down the three-foot prefabricated markers being placed in the ground as control points for preparation of topographic maps by aerial photography. Engineers have tried creosoting the markers to deter the bears, but so far efforts to find a bear repellant have failed.

New Law Attacked

Oregon's new law designed to minimize utility service duplication was attacked as "a monopolistic statute" by Portland's city attorney, Alexander G. Brown, in his legislative report to the city council.

He hinted that the State Grange might propose an initiative measure for repeal of the law, which lets the state public utilities commissioner allocate utility service areas. However, Elmer McClure, grange master, said the group had made no plans for an initiative, although it will "be very watchful in instances where the new legislation is applied."

Portland and several other of the state's large population areas, including Salem and the Eugene-Springfield area, are exempted from the law. Portland fought it on the basis that it would give the PUC allocation authority on outside areas that may be annexed from time to time.

In the legislature the bill was controversial, prevailing by only two votes in the house and one vote in the senate, but was not a clear-cut private vs public power issue. The Oregon REA Assn. and Consumers Power, Corvallis, a large cooperative, favored the bill, considering it would protect them against territory losses to private utilities.

Fast Repair

Ewa Plantation Co. in Hawaii reports fast repair of two electric motors flooded by two 40-hp circulating pumps.

With the stator windings soaked, normal drying would have taken 12 hours.

Instead, Mitsuyuki Fujita, a journeyman machinist, washed the dirt from the coils and blew the water out with compressed air. Then he sprayed the coils with a gallon of CRC-446, a multipurpose compound that ends damage done by water.

The excess liquid was blown off, and an insulation reading showed the motor safe for operation. It worked without any difficulty.

► The Colorado Supreme Court ruled that survivors of a Public Service Co. of Colorado employee, who died while playing softball for a company team, **are not entitled to death benefits under workmen's compensation.** The decision held that PSC received no benefits from the softball team other than that of improvement of employees' morale, that there was no compulsion to participate.

Why Westinghouse is one of world's leading suppliers of nuclear fuel elements and complete cores

Quality Control. High sensitivity, immersion ultrasonic inspection of tubular and plate fuel elements detects flaws and simultaneously provides written records. Other special quality control equipment includes x-ray, chemical, and metallographic laboratories, eddy current and leak testers, and panoramic cameras for filming internal surfaces.

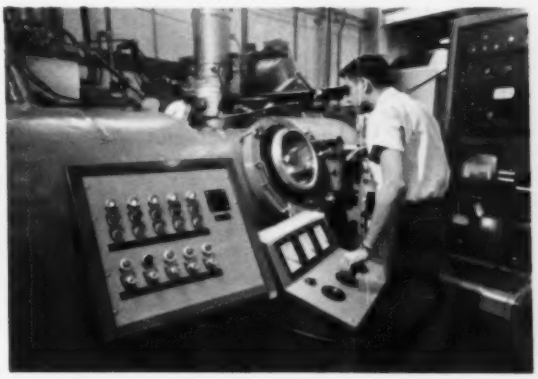
Rods and Assemblies. This technician is welding a stainless steel fuel rod. Westinghouse successfully fabricates aluminum, zircaloy and stainless steel rods and assemblies. Rods can be up to 1" in diameter and up to 130" long. Assemblies can be up to several thousand pounds.

Fuel Development Laboratory. Each job is completely pre-engineered in a commercial fuel development laboratory. This engineer is sintering cermets in an experimental furnace with instrumented vacuum unit. Laboratory has equipment for development work on all types of potential fuel materials and processes.

Modern Equipment. Facilities include pre-sintering and sintering furnaces (shown above), special vacuum welding boxes, vacuum annealing and vacuum induction melting furnaces, autoclaves for corrosion testing, rolling mills for hot and cold rolling, brazing equipment, brake presses for tube forming and plate bending. Other special production equipment includes a 48' high core assembly room with complete optical alignment and gaging equipment.

Atomic Fuel Department. Westinghouse provides industry with a completely equipped, integrated fuel fabrication facility, located at Cheswick, Pa. Products include pellets in any enrichment, pellet loaded and plate-type fuel elements, core components and completely assembled nuclear cores.

High Quality Pellets. Westinghouse can produce solid, hollow or spherical pellets, in sizes from .100" to approximately 1". A.F.D. has three compartmented pellet lines capable of simultaneously producing UO_2 pellets of three different enrichments.



Electron Beam Welder. This 48" diameter, 28' long vacuum chamber encloses a 2 kw, 150 kv electron beam welding head. Unit is capable of welding pieces up to 24" in diameter, 10' long, at speeds up to 100" per minute. Equipment is used for welding aluminum fuel elements and permits closely controlled welds in refractory metals.

JI-59504

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WASHINGTON REPORT

Hanford Reactor

The public-private power fight over authorization of the Hanford Reactor's electric generating facilities quickly became the biggest issue related to power on Capitol Hill in several years. In addition to the direct battle over authorization, the Hanford fight also stalled approval of a public works appropriation bill for fiscal 1962, now several months overdue.

Democrats on the joint congressional committee on atomic energy favored authorization, although Republicans objected. Later, the House of Representatives left Hanford out of its omnibus authorization bill for Atomic Energy projects, by a vote of 173-140. Subsequently the Senate, by nearly a 2-1 vote, placed Hanford in the bill. Still later, the House again objected, by a larger 235-164 vote to Hanford's inclusion.

Chairman Clarence Cannon (D-Mo.) of the House appropriations committee vowed he wouldn't report out the big public works money bill until the Hanford authorization issue had been settled—at least for fiscal 1962. A $95 million Hanford appropriation also was in the appropriation bill, and Cannon wanted to know whether to leave this in the measure, before it went to the floor of the House.

Since the House initiates money bills, the Senate could take up the appropriations measure. Almost all hearings have been completed on the Senate side, however, except for the Upper Colorado transmission lines. Chairman Carl Hayden (D-Ariz.) also vowed he wouldn't allow hearings on Upper Colorado line funds until he knew what the House—at least, the house appropriations committee—planned to do about them.

Regardless of the 1961 battles, supporters of the Hanford project promised to return in 1962 if they lost this year.

► The Senate has passed a bill (S-1501), and sent it to the House of Representatives, which would allow the Bureau of Indian Affairs to **sell any of its isolated utility systems that it found to be inadequate** or inefficient. This includes about 350 small electric systems with about 400 miles of transmission line and 17,000 kw of capacity. Only utilities not involved in the bill are those tied in with irrigation systems. The bureau annually sells about a dozen small systems. One presently proposed for sale would be the Fort Hall, Idaho, electric system, to bidder Idaho Power Co. The company would expand and improve service in the area.

Redevelopment Grant

President Kennedy's two-pronged program to stimulate rural area economies—with rural power systems in the forefront—went into high gear in Washington during the past summer.

The Commerce Department's new "area redevelopment administration" announced designation of 460 depressed counties throughout the nation, qualified to receive $100 million in federal loans and about $25 million in federal public facilities grants to build industrial and other facilities to improve their economies.

The first loan under this program went to Gassville, Ark., to build water facilities to permit a 1,500-employee shirt factory to expand operations. A rural power system will supply power to the factory.

The Agriculture Department's broader but less definite "rural areas development" program also got under way, with creation of a coordinating group in Washington and numerous state groups across the nation. No funds will be used in this program, but agriculture agencies, REA predominant among them, will be promoting rural industrial and commercial development to stir up economies and build rural line loads.

REA, in particular, will stimulate the use of its appliance loan authorization (Sec. 5 of the REA Act), to be used to finance wiring and installing of electrical machinery in new industries. Again, no loans had been made under this program, but REA had received "dozens of inquiries" about it.

REA, also, was completely reorganized by new Administrator Norman Clapp, mainly to improve efficiency, but also to set up a new power section that will deal with, and encourage, loans to co-ops to build their own generation and transmission facilities when REA judges that their wholesale power contracts are "unfair."

► **John W. Mueller** has been named chief of the Bureau of Reclamation's power division in Washington, D.C., replacing **Donald S. Campbell,** who has been transferred to the bureau's engineering office in Denver. Mueller, an electrical engineer, was construction manager for switchyards and transmission lines at the Niagara power project, New York, and before that was a power advisor to the Turkish government—both for the bureau and the International Cooperation Agency. Mueller also worked as a planning engineer in the bureau's Sacramento office.

Snake River Decision Delayed

The long-standing feud over rival hydro power projects on the middle Snake River is destined to go nearly another year before it is resolved.

Rebuttal hearings on the conflicting Nez Perce and High Mountain Sheep projects neared an end in July, then were re-opened for September to hear additional cost analysis testimony by Washington Public Power Supply System. A still later plan by Pacific Northwest Power Co. not to contest the added WPPSS testimony could bring the September session to a quick conclusion, after "housekeeping" details are cleaned up in the hearing.

But filing of final briefs and answers, plus the FPC staff's conclusions, won't take place till about March 1962. A ruling by Examiner William Levy would follow that and, even if it moved quickly, the full commission could hardly rule before late spring or early summer. Court petitions on the final decision, by one or the other party, is almost certain.

Still unsettled—aside from the basic arguments over relative merits of the two big dams—are two major side issues: (1) whether WPPSS will file, and be allowed to file, for an alternate license to build the High Mountain Sheep Dam—instead of PNP—in case the FPC finds High Mountain Sheep more desirable a site than Nez Perce; (2) whether the FPC will accept the request of Interior Secretary Stewart Udall to delay a final decision on the case until 1964, so that Interior can study migratory fish facilities at high dams.

WPPSS plans to seek an alternate application were denied earlier this summer by the FPC on grounds they weren't filed at the right time. The door seems open, however, for a renewal filing at a later date.

Joseph Swidler took over as chairman Sept. 1 from former Chairman Jerome Kuykendall—the only remaining member of the commission since this spring. Kuykendall plans

to stay on for a while, but has said he will resign before his term expires in June 1962. Other new democratic commissioners are Howard Morgan and Lawrence O'Connor. The vacancy left by the suicide of Commissioner Fred Stueck must be filled by a non-Democrat under FPC rules. It can be either a Republican or an independent. No more than three members of one political party may hold office on the commission.

Water Resource Council

President Kennedy has requested —and the Senate interior committee has moved quickly on—legislation to set up a national water resources council at the White House level; various river basin commissions, plus a $5,000,000 annual federal-aid-to-states program for local water project planning.

In addition to recommending the legislation, Kennedy also said he would make the water council's first duty to consider and revise the present feasibility standard (a-47) established by the budget bureau.

The water council would be composed of secretaries of the Interior, Agriculture, Army and Health-Education-Welfare. Interior Secretary Stewart Udall probably would be named its chairman. The council would make a continuing study of water supply needs throughout the nation; establish principles and procedures for preparing comprehensive regional and river basin plans, and for federal water projects; and it would approve or revise plans submitted to it by any of the various river basin commissions set up.

The basin commissions could be set up by presidential directive on request by one or more governors of states affected by any basin. Membership would consist of one representative from each state in the basin, plus representatives from interested federal agencies, compact commissions or international bodies affected. The commissions would be the principal coordinating agencies for federal, state and local planning; they would initiate and prepare long-range comprehensive water plans for their areas, to be submitted to the water resources council; and the commissions would also make annual reports to the council.

Also a $5,000,000 annual federal grant-to-states program, for 10 years, would be set up for local water planning. Federal money would be distributed to states on four criteria: population, area, financial need, planning need.

GROWTH

Launch Hells Canyon

Idaho Power Co. has officially launched construction of the Hells Canyon Dam project. Workmen began building a bridge and an access road leading into the Snake River gorge where the third unit in its new three-dam development will rise.

Company President T. E. Roach said the new bridge and pioneer road—first modern route to penetrate the rocky heart of this deepest of North America's canyons—will be used for transporting the army of construction men and machines needed to build the final huge project in Idaho Power's 1,000,000-kw three-dam development.

Gorge Capability Established

Seattle City Light has established the capability of its recently enlarged Gorge plant to the Skagit River at 175,000 kw, following a three-hour test.

This means that construction of the high diversion dam, installation of high-head turbines and modernization of the generating units increased capacity of the plant by 67,000 kw. Original estimates had been that the work would increase the capability from 108,000 to 165,000 kw.

Enlargement of the Gorge plant raises City Light's total generating capability to 787,000 kw, of which all except 61,000 is hydro. This figure will be increased to well over 1,000,000 kw with construction of Boundary Dam on the Pend Oreille River, for which FPC approval was recently secured.

Loon Bids Rejected

Directors of the Sacramento Municipal Utility District have turned down bids for construction of the Loon Lake Dam unit of the district's Upper American River power and water project.

Henry J. Kaiser of Oakland and Raymond International of New York have submitted a low bid of $7,425,499 for the work. It was one of three bids.

Clyde H. Spencer, SMUD project engineer, and Bechtel Corp., the district's consulting engineer, recommended rejection of the bids. Spencer said the low offer was $2,000,000 over engineer estimates.

Spencer got permission of the SMUD directors to revise the construction schedule in an effort to reduce costs. Separated from the main project, Spencer said, will be construction of an access road and clearing the reservoir area.

Canada Gas Pipe Line

Construction of the $300 million Alberta-California natural gas pipe line has passed the half-way mark and is ahead of schedule in most sections, according to Pacific Gas and Electric Co. President Norman R. Sutherland.

"We expect that the pipe line will be ready for deliveries to California in November, as planned," the PG and E president said.

More than 4,000 men are at work building the 36-in.-diameter pipe line. The line will carry Canadian natural gas to northern and central California consumers.

Pacific Gas and Electric is building the California section of the pipe line system, Pacific Gas Transmission Co. the Oregon-Washington-Idaho section, Alberta Natural Gas Co. the British Coumbia section and the Alberta Gas Trunk Line Co. Ltd. the Alberta section.

Puget Transmission

Puget Sound Power & Light Co. has been granted permission to construct transmission lines through parts of the Lakes district south of Tacoma, with the provision they will not be used as service lines to new customers in the area.

Tacoma City Light and Lakeview Light & Power Co., a cooperative, had objected to the franchise, as invading territory that they serve. The board of Pierce County Commissioners refused to be drawn into a debate between public and private power, however. The lines will transmit power to Olympia, some 20 miles south of the Lakes district.

John Day Turbines

The Baldwin-Lima-Hamilton Corp. of Philadelphia is apparent low bidder at $15,394,200 to furnish 13 turbines, of which 10 with a combined capacity of 212,400 hp will be installed at the $423 million John Day Dam being built on the Columbia River. Army Engineers of Walla Walla, Wash., say these turbines are the largest of their type in the world.

A SCALE MODEL of Portland General Electric Co.'s Round Butte spillway tunnel and outlet is being tested at Pullman, Wash., in the State University hydraulic laboratory. Here M. L. Dickinson, chief hydraulic engineer for Bechtel Corp., goes over the model with an interested group. PGE has awarded contract for the diversion tunnel for the $68 million Deschutes project to Peter Kiewit Sons Co. of Omaha on a low bid of $3,216,454

The other three will be for the $150 million Lower Monumental Dam just being started on the Snake River.

The turbines, propeller type with adjustable blades, will turn generators with capacity of 135,000 kw each.

Huntington Beach Nos. 3 and 4

Two new generating units at Southern California Edison Co.'s Huntington Beach steam station are now in full operation, making it the largest single power source on the Edison system, it was announced recently.

With completion of the fourth unit, rated at 225,000 kw, the station now has a total generating capacity of 870,000 kw—enough electricity to serve a city of more than a million population, according to James F. Davenport, Edison executive vice president.

The huge installation now represents a total Edison investment of about $110 million, Davenport said. He termed the station "a model of engineering automation which utilizes all the latest advances in the art of producing electricity from steam."

► Alcoa's Wenatchee, Wash., reduction plant received its first power from **Rocky Reach Dam** on Aug. 1, Chelan PUD reports. The company is now receiving 104,000 kw of PUD power, equivalent to the production of one generator. A contract provides that Alcoa will get 23% of the dam's production.

Sultan Development

Shortly after receiving a construction license from the FPC, the Snohomish County PUD invited bids for the first contract involved in a $45 million development of the Sultan River for power and water.

The initial contract involves two miles of access road to the first of three proposed dams. Proposals will be called later for first-stage construction of the dam, a concrete arch structure with an ultimate height of 242 ft. The first-stage contract will construct the dam to a height of 140 ft, creating 20,000 acre-ft of usable storage for the Everett water department.

Revised Wells Application

Douglas County PUD of Bridgeport, Wash., has filed a revised application with the FPC seeking a license for the proposed Wells hydroelectric project on the Columbia River in Douglas, Chelan and Okanogan Counties.

As revised, the proposed project would consist of a dam about 130 ft high and about 4,150 ft long comprised of impervious-core earth-fill embankments connecting both abutments to a central concrete structure, which incorporates two outboard fish ladders and 11 gated spillways alternating with 10 generator structures. The project would have an initial seven units with provisions for the installed capacity of 494,095 kw in seven units with provisions for the future installation of three additional generating units having a combined capacity of 211,755 kw.

PUD Buys Substation

Chelan County Public Utility District commissioners at Wenatchee, Wash., recently approved purchase of the Berne substation in Stevens Pass from Puget Sound Power & Light Co.

The substation is located near the east portal of the Great Northern Railway Co. tunnel through the Cascade Mountains. It serves the giant fan system installed by the railroad in 1956 to permit use of diesel locomotives in the tunnel. The railroad previously operated electric-powered locomotives in the tunnel. An agreement between the PUD and Puget Sound Power & Light in 1956 provided the framework for the ultimate purchase of the substation.

At that time, the PUD purchased Rock Island Dam, on the Columbia River, and the Chelan County portion of the transmission line from the dam to Skykomish. The transmission line is tied in with the substation.

PUD Manager Kirby Billingsley said the PUD took over operation of the substation July 1. Puget Sound Power & Light, on the same date, assigned to the PUD the contract with Great Northern for providing power for the fan system.

Billingsley said estimated annual revenue from the railroad fan power contract is $15,000.

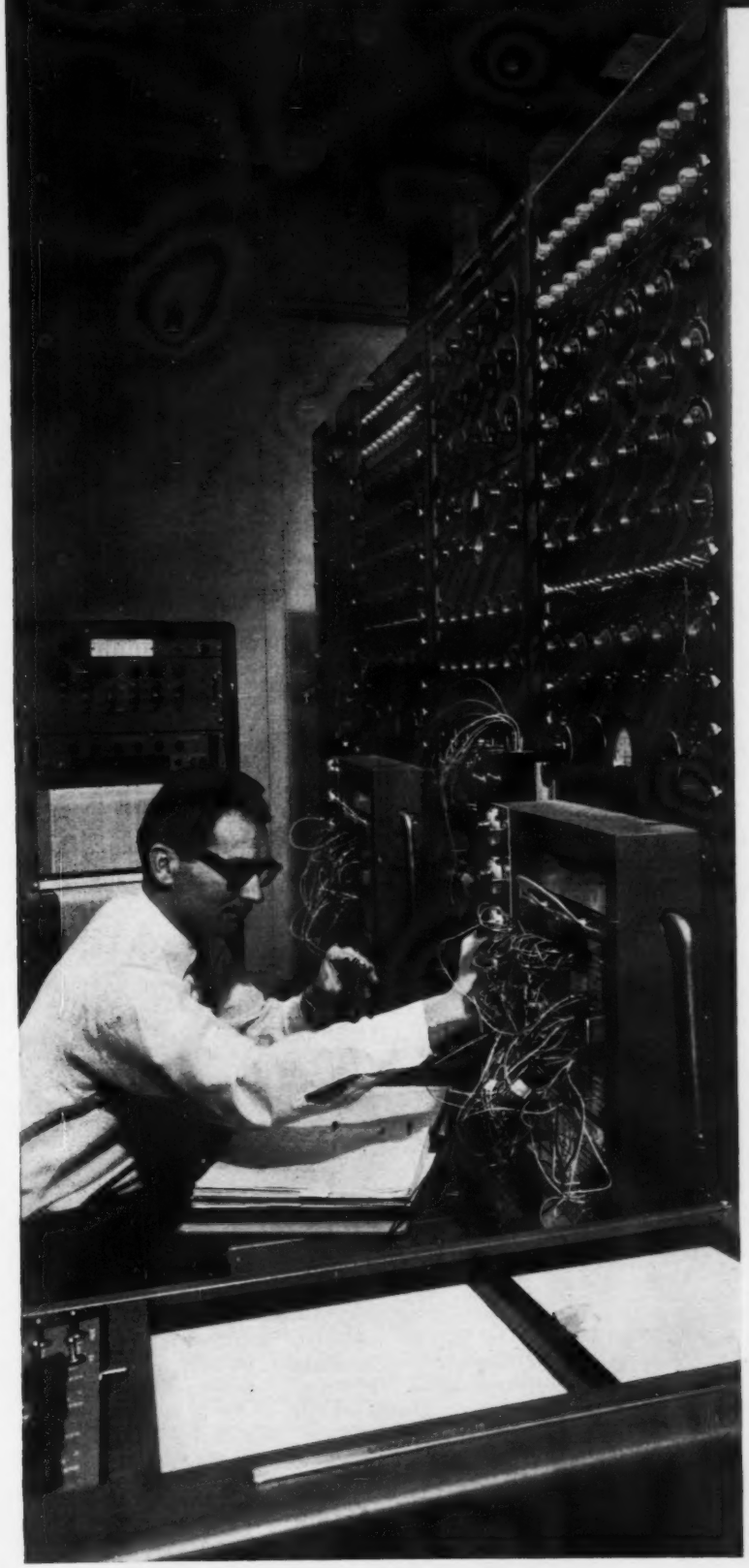
New Don Pedro

Turlock and Modesto Irrigation Districts have filed a joint application with the FPC seeking a license for a new Don Pedro hydroelectric project on the Tuolumne River in Tuolumne County, Calif.

The new Don Pedro project would consist of a rock-fill dam about 545 ft high, creating a reservoir with a gross storage of 2,030,000 acre-ft, and a power house with an installed capacity of 131,100 kw. The cost of the proposed project is estimated at $78,620,000. The new dam would be built two miles below the present Don Pedro Dam and would flood the old dam by 225 ft. The capacity of the existing power plant is 30,000 kw.

The two districts would distribute power generated at the project to customers in Stanislaus and Merced Counties, Calif.

ANOTHER STEP AHEAD IN VOLTAGE REGULATION



COMPUTER STUDIES BY GENERAL ELECTRIC PROVE . . .

Reduced Regulator Bandwidths Increase System Earnings

General Electric voltage regulators provide three added benefits to distribution systems through bandwidth reduction . . . extra feeder length, capacity, and revenue! New G-E computer studies now prove that *reduced regulator bandwidths are practical* and that they result in increased distribution system performance with *no sacrifice of regulator life.*

Electric utilities have long recognized the desirability of bandwidths as low as ±¾ volts. The assumed stumbling block was the number of regulator operations. Through analysis of actual (as opposed to theoretical) data, these studies indicate that bandwidths of ±¾ volts are feasible from any standpoint, including that of equipment life.

Your General Electric regulator representative can show you the specific effects of reduced bandwidths on regulator operation. He will show you how to determine if operations must be controlled . . . and if so, how to control them.

And he will illustrate how these reduced bandwidths can now be easily set with G.E.'s exclusive new Micro-Band* voltage regulating relay —the first to offer you *calibrated adjustment* of both voltage level and bandwidth.

Micro-Band relays make possible more *usable* kva on the line. This easily attainable "power adder" can mean increased line length and capacity—important tools to increase feeder revenue.

To increase the return on your regulator investment—possibly with your existing equipment—get the full story on Micro-Band calibrated relays and reduced bandwidths from your G-E Sales Engineer. General Electric Co., Schenectady 5, N. Y. 456-02A

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NUCLEAR NEWS

Nuclear Power for Nevada

A fact-finding committee on nuclear energy for the State of Nevada held a two-day forum in Reno, Nev., June 29-30 on the feasibility of using nuclear energy for the production of electricity in that state. The committee, made up of 13 citizens appointed by the governor, heard presentations by the AEC, General Electric, Atomics International and Advanced Technology laboratories.

Announced publicly for the first time were plans by the Sierra Pacific Power Co., which serves much of northern Nevada, to build a 75,000-kw nuclear power plant near Reno between 1965 and 1970.

Purpose of the forum was to gather facts, and to stimulate interest by the public and by industry over the possibility of putting nuclear plants in a very high cost fuel area. The forum was told that it was now economically feasible to build nuclear plants in the state that could generate power cheaper than coal or oil plants.

Uranium-233 Fuel System Critical

A U-233 fuel system has produced a chain reaction for the first time in a commercially sponsored nuclear facility.

Operation of the machine, called a "critical assembly" with this fuel system is part of the Advanced Epithermal Thorium Reactor (AETR) project conducted for Southwest Atomic Energy Associates by Atomics International. It is the second in a series of experimental cores to be operated in the machine to study the nuclear characteristics of a full-scale power reactor.

It also marked the first time a fuel blend of thorium and U-233 has been used to start and operate a critical assembly. This type of fuel provides for longer burn-up, through better neutron economy, than other types of uranium.

The AETR research and development program is sponsored by a group of 15 investor-owned utilities in the Southwest.

Fuel Core Tested

The nuclear power core—valued at $22,000,000—for the nation's largest stationary nuclear electric generating station being built by the Consolidated Edison Co. at Indian Point, N. Y., has achieved its first sustained chain reaction at the Babcock & Wilson Co. Atomic Energy Division laboratory.

The test was a pioneering accomplishment in that it was the first time a **full-scale** power reactor core using a mixture of thorium and uranium oxides had ever been taken to criticality.

Three million pellets, each one-quarter by three-quarters of an inch, make up the core's fuel charge. Weighing about 40 tons, the assembled core of fuel elements stands eight feet high and measures six feet across.

Now nearing completion, 24 miles north of New York City on the east bank of the Hudson River, the Con Edison Indian Point station will be capable of producing 275,000 kw of power. Part of its total output will result from routing the steam generated by the reactor system through a conventional oil-fired superheat cycle before it reaches the turbogenerators.

Long-Term License for Yankee

The AEC has amended the license of Yankee Atomic Electric Co. of Boston to permit operation of Yankee's pressurized water reactor at an increased power level of approximately 136,000 kw.

The amendment, dated June 23, also extends the expiration date of the Yankee license to Nov. 4, 1997, revises the technical specifications and provides for reporting requirements suitable for a permanent operating license.

Yankee has been operating its reactor at Rowe, Mass., at a power level of approximately 11,000 kw. Both the commission's advisory committee on reactor safeguards and the AEC regulatory staff have concluded that the Yankee reactor can be operated at the increased power level without undue hazard to the health and safety of the public.

► **In the first decision** of its type rendered under the Atomic Energy Act of 1954, the Supreme Court recently upheld the Fermi construction permit. Basically the decision says: (1) the AEC may issue construction permits for nuclear power plants; (2) that construction may begin with a program for the development of safety provisions carried out concurrently; (3) that proof of "compelling reason" need not be shown as a substantiating reason for locating a nuclear power plant near population centers. This is said to clear up much of the doubt in planning.

COMMUNICATIONS

Procedure Simplified

FCC and FAA finally got together long enough to avoid producing a real hardship on radio users. As you may recall, the FAA got to feeling its oats last spring and produced Part 626 of its regulations placing the responsibility for investigation and approval of antenna structures directly in its hands instead of through the FCC.

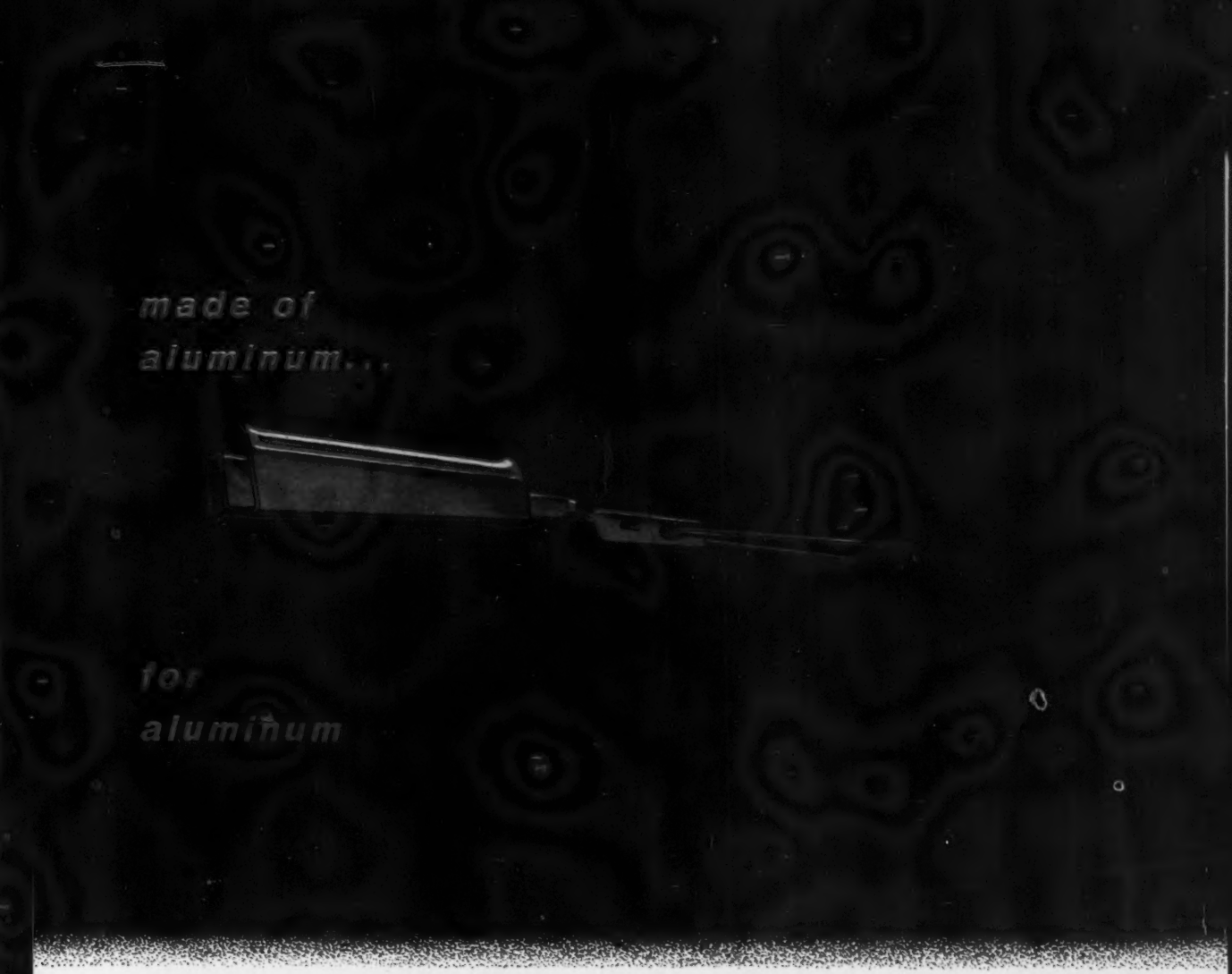
Most disrupting to the radio user was the requirement that an FAA form No. 117 was to be submitted 30 days prior to the presentation of the radio application to the FCC. This, coupled with the 30-day "protest" period now in effect for certain classes of fixed stations, could mean a 60-day delay before the FCC would even see an application. In a crash session, officials of both bureaus came up with the decision that the FAA notice could be mailed at the same time that the application for radio authorization was sent to the FCC. Thus the "protest" period and FAA investigation could run concurrently.

Generally speaking, **if you are planning a tower more than 150 ft in height** anywhere, or any kind of support for an antenna that is over 20 ft above ground or other structure on which it is mounted, and within several miles of an airport, get a copy of Part 626 and Form 117 from your nearest FAA regional office.

Not to be outdone, the FCC has prepared another form which must be submitted with your application, to show that the FAA has been notified.

If this all sounds confusing, wait until you get the instructions for filling out the forms.

► Wally Blankmeyer of Montana Power Co. reports that he has become enamored of and fascinated by **high gain antennas** for mobile radio. An omnidirectional recently installed at Cutbank has a gain of 13 db in the 150-mc band. Coverage has been found to be very complete over a very large area with a marked reduction in previous shadow areas. Since the 13-db gain is equivalent to a 20 to 1 increase in power, and it is equally effective in improving reception, there is a lot of merit in utilizing such antennas. The price of this particular antenna is under $500, which is reasonable because it makes even the smallest base station look like a quarter kilowatt. Other



ALL-ALUMINUM WEDGE CLAMPS

SERIES AA

eliminate bi-metal contact and galvanic corrosion
for stronger, longer lasting service dead-ends

Blackburn Series AA Wedge Clamps are designed and engineered for use with aluminum neutral messengers at service dead-ends.

Construction is heavy-gauge, high strength aluminum alloy. This aluminum-to-aluminum contact eliminates galvanic corrosion between dissimilar metals.

No need to thread the cable through the clamp. Because slider is removable, the clamp can be easily installed anywhere on a continuous run of conductor. Wedging action, as strain is applied to the neutral, grips tightly along the entire length of contact. Re-establishing proper sag is quick and easy.

Two types of bails available for easy installation: flexible strand with nylon jacket or rigid stainless steel, locked to wedge so it won't pop loose.

You can reduce inventory with this versatile series of clamps. Only four sizes will dead-end a range of cables from #6 solid through #4/0 ACSR.

Blackburn Wedge Clamps are also obtainable in chromated aluminum for highly corrosive atmospheres and in stainless steel for copper neutral messengers.

The entire line of Blackburn Wedge Clamps is available from your electrical distributor.

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tests conducted with several kinds of half-wave base loaded high gain antennas indicate that they too are effective in improving operation. Most of this variety have only small gains in the vicinity of 2 db. However, this isn't to be sneezed at if you are now using 30-w mobiles and feel you should go to higher powers. It costs only peanuts to try.

New FCC Ruling

Use of 952-mc frequencies by electric utilities should increase as a result of a recent ruling by the FCC. The new regulations provide for pairing of frequencies 100 kc apart, duplex and simplex operation, power inputs as high as 100 w and, most interesting of all, omnidirectional operation on specified frequencies. Two possible uses that could appeal to the electric utility user would be control of street lighting and capacitor banks, or perhaps even small substations if a sufficient number could be reached in one area. Some of these uses would be on a developmental basis only since the commission has indicated that it wishes to obtain more information on omnidirectional operation at microwave frequencies. Part 11, as modified by this order, should be consulted for details.

Fire Damage

Considerable damage was sustained in Idaho Power Co.'s Boise communications shop when fire destroyed part of the building in which it was housed. Fortunately, the fire was brought under control before most of the shop equipment was badly damaged from heat; however, water and smoke apparently permeated nearly everything that was not hermetically sealed and caused corrosion and sticking of moving parts. After cleaning up and drying, a surprising amount of the electronic equipment was found to be in operating condition, or repairable.

► General Electric Co. has announced the installation of its **new solid state supervisory control** and monitoring system in several substations of Western Massachusetts Electric Co. This is probably the first installation of such equipment in this country and very likely is a preview of the form which most systems will take in the future. In the West, Utah Power & Light Co. will shortly be installing the same system, thus giving us a chance to take a look closer to home.

MARKET DEVELOPMENT

ANTIQUE: Portland General Electric didn't mind taking in this 1900 model Kalamazoo wood range in its recent Trade-Up promotion. Its promotion department had been looking for just such an antique for "then and now" displays. The range had been in daily use until Hogg Bros. Appliances of Oregon City persuaded its owner to take advantage of PGE's offer to give allowances on old ranges where a new electric was installed. From left in picture are Kenny Kennedy, Hogg; Lud Fortuna, PGE commercial representative; and Art Kuehn, Hogg

Appliance Use Up

Some 78,000 families served by Portland General Electric Co. plan to purchase 136,000 electric appliances, according to a recent company survey. These families, who said they were "very sure" to buy one or more appliances, represent 34% of the families served by the utility.

An additional 45% said they were "fairly sure" to buy an appliance, while 23% were "not very sure."

With the exception of conventional washers and garbage disposers, appliances showed saturation increases since the last survey was made in the fall of 1958. Ranges were up 3% to 89%; automatic washers, up 11% to 70%; clothes dryers, up 10% to 53%; electric blankets, up 13% to 47%; home freezers, 37%; automatic dishwashers, up 5% to 17%.

Fifty per cent of the customers surveyed said they would prefer electric heat if they were moving into a new home.

► Although it gave the lie to advertising boasts of an "air conditioned climate," Oregon's **unusual summer heat was good for air conditioning sales.** Pacific Power & Light Co. reports that June sales were more than three times higher than those of June 1960 (1,394 to 423 units) and that indications were for a continued high level in August. Portland General Electric Co. said that sales on its system ran 100 a day during high temperatures as compared with a normal of 10 a day and estimated that summer sales will be 350% higher than totals of the past two years.

► **Honolulu Electrical Products** Co. has promoted **C. W. Shafer** from sales manager of its major appliance department to a new post of consumer products manager. Other advancements announced by T. E. Ludlam, vice president and general sales manager, were: **E. J. Dunn,** former manager of the specialties department, to sales manager of the wholesale appliance department; **R. M. Bovee** to sales manager of the new Ala Moana retail store; **Robert A. Kemp** Jr. to sales manager of the supply department. Kemp takes over the post held by **William S. Willis,** who has retired after 22 years.

► General Electric Co. has opened a **$750,000 major appliance distribution center** to serve Oregon, southwestern Washington and northern California. The new center, located in suburban Beaverton, west of Portland, provides 51,546 sq ft of floor space for offices, display rooms, service and parts handling and warehouse facilities. Wayne H. Hughes, Portland district sales manager, was host at an open house to community leaders, architects, contractors and appliance dealers.

WHEN THE FUTURE IS ALL-ELECTRIC

WHY BUY ANYTHING BUT A ***TOTAL-ELECTRIC GOLD MEDALLION HOME?***

"In our new Gold Medallion Home, we get so much more of what we're really *living* for," says Mrs. Nowers. "I have more time for my family and for my community work, and I'm a much better home manager since we moved in. A home without everything electric would seem old-fashioned to me now. I'll never go back."

Count the things that change for the better:

1. Flameless electric heat. "It's like living in mild sunshine," says Mrs. Nowers. "Our walls and drapes stay remarkably clean."

2. A flameless electric range. "So cool and *fast*. And no other way to cook is nearly so clean."

3. A flameless electric oven. "The same good things can be said about my electric oven. In addition, the juice stays in the meat because I cook with heat that's moist, not dry."

4. A flameless electric dryer. "My clothes dry even sweeter and fluffier than they used to outdoors. I don't get any baked-in wrinkles, either."

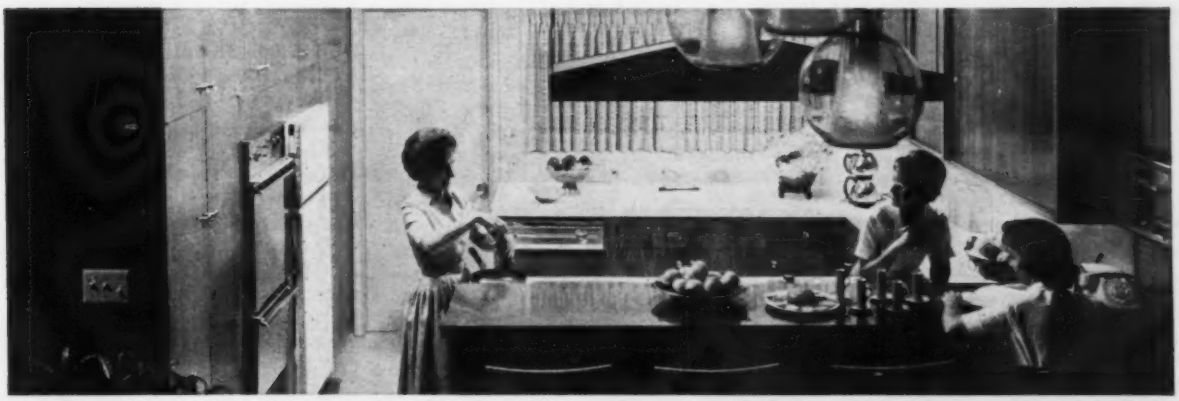
5. A flameless electric water heater. "We get all the hot water we want, quickly and inexpensively," says Mrs. Nowers.

WHAT IS THE GOLD MEDALLION HOME AWARD?

It is an award given only to total-electric homes that are electrically up-to-date. When a new home meets Gold Medallion Home requirements you know it offers: *clean, flameless, electric space and water heating; a clean, flameless, electric kitchen*, equipped with major appliances; plenty of "*Housepower*"—modern wiring to handle today's and tomorrow's appliances; *abundant lighting*, planned for comfort, convenience and beauty.

It costs so little to live better electrically. Why not move up to a total-electric Gold Medallion Home?

SOUTHERN CALIFORNIA Edison COMPANY



Home of Dr. and Mrs. Walter J. Nowers, Palos Verdes Estates, California. Earl R. Mason, A.I.A., Architect.

ASSOCIATION AFFAIRS

ELECTRIC HEATING interests bankers as well as electrical people, a cooperative seminar at Reno has established. The electric heat seminar was presented jointly by Sierra Pacific Power and Emerson Electric companies. Here Marshall Crawford, assistant cashier of Nevada Bank of Commerce, North Reno branch, left, receives a certificate of achievement from Bruce Ross, electric heat specialist of Emerson Electric's Western Division. Subjects covered in the seminar were user benefits, fundamentals of electric heating, estimating costs, equipment available and sales techniques. The seminar was attended by 27 electrical contractors and dealers, Sierra Pacific personnel and designers and builders

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►Portland General Electric has made **two changes to facilitate bill paying.** All customers may now pay their electric bills at any branch of either the United States National or First National Banks of Oregon. Electric heat customers may be billed on an equal pay plan at their request. The equal pay plan levels out the winter peak of electric heat bills.

► Although it cannot point to the exact location, **Pacific Gas and Electric Co. recently connected its two millionth electric customer.** With the addition of nearly 5,000 customers every month, it would be impossible to pin it down even with the aid of electronic data computers, S. L. Sibley, vice president and general manager, stated. The company's one millionth customer was connected in 1943.

► **Saul E. Levi** has been named district operations manager of **Westinghouse Appliance Sales** in Los Angeles, with headquarters at 4601 S. Boyle Ave., Vernon, Calif. Levi formerly was manager of the company's distribution center in San Lorenzo.

NAED

To a series of area meetings for the members of National Association of Electrical Distributors, Arthur Hooper, executive director, brought the new format for the operations of that association as developed at the recent convention in Detroit by the board of governors. Accompanying him was Frank Blackwell, recently appointed field representative for the Western part of the United States.

Area meetings were held at Apple Valley June 2 and 3 for the southern California, Arizona and southern Nevada members; at Yosemite Park June 9 and 10 for the northern California and northern Nevada members; in Portland June 13 for the Oregon members and at Idaho Falls June 16 and 17, under board of governors member Joe Wright, Afton-Lemp Electric, Boise, for the mountain states members. Another meeting was to be held later for the Denver area but the date had not been set.

The new program calls for area meetings of this type at frequent intervals and an annual regional meeting which will be somewhat of a convention and which may have manufacturers' consultation booths similar to previous national conventions. After next year, it was announced, the national conventions will be for members only and on a smaller scale, thus making the regional conventions of more importance and to giving wholesaler members contact with the manufacturers at a local level.

While the programs of the area meetings have not been made available, that at Apply Valley was under the direction of Ken Rehwaldt, General Electric Supply Co., regional vice president. That at Yosemite was under the direction of Earl Morton, Westinghouse Electric Supply, San Francisco, governor for the area, and John Taylor, Incandescent Supply, area chairman. That program had on it as speakers M. J. Burress, president of Tay Holbrook Co., and immediate past president of the Northern California Suppliers Assn. He discussed recent trends in legislation affecting distributors. At the open session June 10 Tom Mellon, president, Wesix Heater Co., discussed the relationships necessary between manufacturers and distributors and made a special appeal for wholesaler participation in electric heat promotion lest it get away from the electrical industry into the hands of other industries.

An outside view of the distributors' business was presented in a lively dialogue between C. W. Leihy, publisher, and Jack Robinson, editor, of ELECTRICAL WEST.

► **A Rocky Mountain Section of the Residential Lighting Forums** was chartered as a division of the Illuminating Engineering Society, Rocky Mountain Section, Denver, recently. Fred H. Rosenquist and Don Kingston also represent the Academy of Lighting Arts, a coordinating agency. Officers elected were Harold E. Brandt, Westinghouse Electric Corp., chairman; Mrs. Gladys Kline, Bill Kline Associates, vice chairman; Mrs. Frances Beason, Poindexter Electric Co., secretary; William M. Campbell, Pryor Realtor, treasurer.

AT NAED's Yosemite meeting: Frank Blackwell, Western field representative; Earl Morton, Wesco; Arthur Hooper, NAED executive director; John Taylor, Incandescent Supply

fold down

...and
take
your
first
look
at
"Tiny Tim"™–
the
world's
smallest
50-KVAR
power
capacitor

50-KVAR "Tiny Tim" case dimensions: 15" high x 4½" wide x 13½" deep. Weight: 62 lbs. 100-KVAR "Tiny Tim" case dimensions: 28¼" high x 4½" wide x 13½" deep. Weight: 115 lbs. Ratings: 2400 through 7960 volts, 60 cycle, single phase, with single or double bushings.

It's not just the smallest (no big
but also the lightest: 62 pound
meets NEMA standard mountin
to you are obvious: in sub-stati
tribution systems. Along with
famous Cornell-Dubilier 99.6%
Bulletin 8150 explains all. Ask
copy, or write: Power Factor Ca
Pacific Electric Co., 333 Hamil

(actual size!)

o bigger than conventional 25-KVAR's)
ounds. We also have a 100-KVAR that
unting dimensions for 50's. Savings
stations, on poles—in utility and dis-
with these savings, you still get the
.6% trouble-free operating rate. Our
. Ask your FPE sales engineer for a
or Capacitor Marketing Dept., Federal
lamilton Blvd., South Plainfield, N. J.

PCEA Appointments

Evidence that the PCEA's "new administration" is in high gear and moving fast is seen in President H. G. Dillin's announceemnt of the following section and committee chairmen. All chairmen and committee appointments have not yet been verified, but their announcement is expected shortly, he said.

Administrative Services

D. M. Pritchett, California Pacific Utilities, San Francisco, chairman; O. H. Murdoch, Southern California Edison, Los Angeles, vice chairman.

Joint fall conference, Miramar Hotel, Santa Barbara, Nov. 27-28, 1961; **joint spring conference,** Villa Hotel, San Mateo, March 26-27, 1962 (followed on March 28 by one-day invitational round-table discussion of EDP problems).

Business Development

R. H. Phillips, San Diego Gas & Electric, chairman; W. D. Howell, PG and E, San Francisco, vice chairman—industrial, commercial and agricultural; L. H. Shaff, Arizona Public Service, Phoenix, vice chairman—residential.

Conference, Huntington-Sheraton Hotel, Pasadena, Feb. 26-27, 1962.

Engineering and Operating

H. S. Warren, Rome Cable Division, Alcoa, Los Angeles, chairman; H. R. Daniels, PG and E, San Francisco, vice chairman.

Conference, Sheraton-Palace Hotel, San Francisco, March 22-23, 1962.

Accident Prevention—C. E. Eddy, California Electric Power, San Bernardino.

System Protection—W. A. Davis, San Diego G&E.

Agricultural Electrification — F. H. Coover, So. Calif. Ed., chairman; W. E. O'Brien, PG and E, Chico, vice chairman.

Commercial Cooking—G. F. Burgess, Calectric, chairman; Charles Schuermeyer, PG and E, Fresno, vice chairman.

Heating & Air Conditioning—H. Z. Andrade, General Electric, Los Angeles, chairman; S. L. Forsyth, Montgomery Bros., San Francisco, vice chairman.

Home Economics—Lorine M. Craft, Westinghouse, Los Angeles, co-chairman; Evalyn Vaughan, PG and E, Stockton, co-chairman.

Industrial Equipment—D. W. Struck, San Diego G&E, chairman.

Lighting, Commercial & Industrial—R. E. Dahlin, So. Calif. Ed., chairman.

Lighting, Residential—A. O. Grotenhuis, Thomas Industries, Los Angeles, chairman; J. W. Howard, G-E, Oakland, vice chairman.

Wiring, Residential — A. J. McCutcheon, San Diego G&E, co-chairman; N. W. Schiewe, G-E, San Francisco, co-chairman.

4-H Club Electric Project—R. R. Whittaker, Calectric, chairman.

Code and Ordinance—W. S. Flowers, PG and E, San Francisco, co-chairman; A. C. Veit, Los Angeles County inspector, co-chairman.

Residential Street and Highway Lighting—T. M. McDaniel Jr., So. Calif. Ed., chairman.

Residential Street and Highway Lighting *Technical Subcommittee*—B. A. Corwin, So. Calif. Ed., chairman.

Radio and TV Interference Problem — K. E. Dueker, So. Calif. Ed., chairman.

► **Lloyd A. Gates,** Los Angeles Department of Water & Power, was elected as the new president of the **Electrical Maintenance Engineers Assn.** of California after the election of a new executive committee. William R. Paluska, Albert C. Martin & Associates, is first vice president; Norman E. Stone, Traffic Appliance Corp., is second vice president; Richard B. Hatfield, Southern California Edison Co., is secretary-treasurer. The new executive committee members elected for a three-year term are: K. Lee Alvey, Airesearch Mfg. Co.; Walter Jahnke, Jahnke Electric Co.; Ormand C. McGinty, Southern California Gas Co.; William A. Rinehart, Burton Equipment Co. Continuing members are Ernest A. Burgess, King D. Christopher, Clark Controller Co.; John Horsburgh, Kaiser Steel; and Robert R. Procter, Larsen-Hogue Electric Co. Retiring officers are Oswald D. Land, industrial engineer, who was president, and Urban Beh, consulting lighting engineer, first vice president.

► **Electrical Maintenance Engineers Assn.** of the Columbia Basin has elected James Poage, General Electric Co., Portland, as president. Other officers are: Edward L. Hurd, J. A. Tudor & Associates, vice president; William Gillen, G. M. Philpott Co., secretary; and David Schuler, Bearing Sales & Service Co., treasurer. Board members are: William Gennell, Helt & O'Donnell; Robert Atwood, W. R. Grasle Co.; Milton Shelton, Ocean Accident & Guarantee Co.; and M. H. Mitchell, Adams Electric Co.

► **Electrical Apparatus Service Assn.** (formerly NISA) has announced through its president, George Larsen, Larsen-Hogue Electric, Los Angeles, that August A. Baechle, who joined the headquarters staff at St. Louis last September as staff engineer, and formerly from Allis-Chalmers Mfg. Co., has been appointed executive vice president. He has been acting in that capacity since May.

► **Utah Section, American Institute of Electrical Engineers,** which was host to the AIEE Pacific General Meeting, Aug. 23-25, in Salt Lake City, has elected C. R. Lufkin, sales manager of marine and defense facilities sales, General Electric Co., as chairman to succeed R. W. Moody. Other officers are J. N. Jones, Westinghouse Electric Corp., vice chairman; R. K. Bertoch, Wasatch Electric, secretary-treasurer.

PEOPLE

► **Frank E. Lucking** has been elected commercial vice president of California Electric Power Co. and will be responsible for sales, customer services and public relations activity. He has been with Calectric for the past 37 years and has served as commercial manager since 1958. During his service he has held positions as local superintendent in Calipatria and Holtville, has served as district manager at Barstow and Victorville and district manager of the company's Perris-Elsinore operations.

Lucking

► **Lewis R. Knerr,** manager-rates and valuation for San Diego Gas & Electric Co., was elected vice president-management services by the utility's board of directors. In addition to his present duties, Knerr will assume administrative and management functions relating to employee relations, purchasing, insurance, safety and claims. Several of these new assignments have been the responsibility of **Hugh Stewart,** executive engineer, who retired Aug. 1 after 39 years with the utility. Before joining San Diego Gas & Electric in 1956, Knerr was a consulting engineer in Oakland, specializing in work related to public utility operations. Previously he had been with Great Western Power Co. and PG and E.

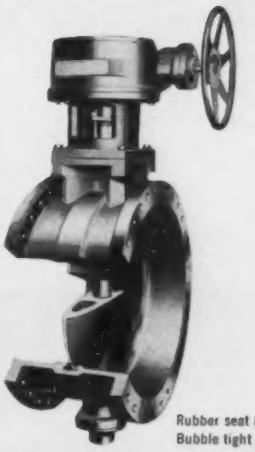
Knerr

► **Dr. A. E. "Dal" Grauer,** chief executive officer of B. C. Electric Co., died July 28 at his home in Vancouver. His death at age 55 came just before the takeover of his company by the provincial government. He had been suffering from leukemia since May and was hospitalized following a speaking tour in England. An honors student, Dr. Grauer held PhD and LLD degrees. He was a former university professor and at the time of his death was chancellor of the University of British Columbia. A world recognized business authority, he joined B. C.

(Continued on p 64)

Henry Pratt Equipment for Nuclear Power Plants

Many of the nuclear power plants in the United States are using equipment designed and built by the Henry Pratt Company . . . a strong indication that this company can meet the stringent requirements for nuclear equipment . . . truly dependable operation plus maximum safety. Even in this new science, Henry Pratt can offer informed experience plus the creative engineering and manufacturing skills to bring new ideas into useful reality.



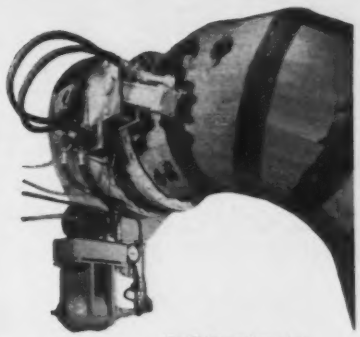
Rubber seat butterfly valves. Bubble tight to 125 psi.

Henry Pratt Equipment for many uses

Valves:

- **Rubber seat butterfly valves for fluid control**
- **Quick closing ventilating valves**
- **Dampers (tight closure)**
- **Reversing valves (for condenser water circulation)**

Air Locks for personnel and equipment
Expansion joints
Doors
Fuel Locks
Cavity Liners



Ventilating valves close in ⅛ second or less

Equipment now in use at:

Shippingport Atomic Power Sta. Duquesne Light Co.
Dresden Nuclear Power Sta. Commonwealth Edison
Yankee Atomic Electric Co.
Consolidated Edison Thorium Reactor
Enrico Fermi-Atomic Power Plant Power Reactor Development Co.
Hallam Nuclear Power Facility, Sheldon Sta. Consumers Public Power District
Humbolt Bay Power Plant Unit No. 3 Pacific Gas & Electric
Rural Co-op. Power Assoc. Elk River, Minn.
Experimental Boiling Water Reactor Lemont, Ill. (Argonne) (EBWR)
Vallecitos Boiling Water Reactor GE & PG & E
Experimental Breeder Reactor No. 2 NRTS, Idaho (Argonne) (EBR-2)
Boiling Reactor Experiment No. 5 NRTS, Idaho (Argonne) (Borax-5)
Saxton Nuclear Experimental Reactor Porject
Experimental Gas Cooled Reactor AEC & TVA
Plum Brook Reactor Facility – NASA
Engineering Test Reactor – NRTS Idaho
Italy – ISPRA
Boiling Reactor Nuclear Superheat Proj. Puerto Rico Water Resources Auth.
Wright Patterson Air Force Base
City of Piqua, Ohio – OMR – Facility
Plutonium Recycle Critical Facility
Livermore Pool Type Reactor
Ames Research Reactor
Massachusetts Institute of Tech.
University of Buffalo
Iowa State University
Worcester Polytechnic Institute
Ohio State University
Cornell University
Georgia Tech Reactor

Personnel lock contains incident forces without leakage

Literature is available on each Henry Pratt Product.

HENRY PRATT®

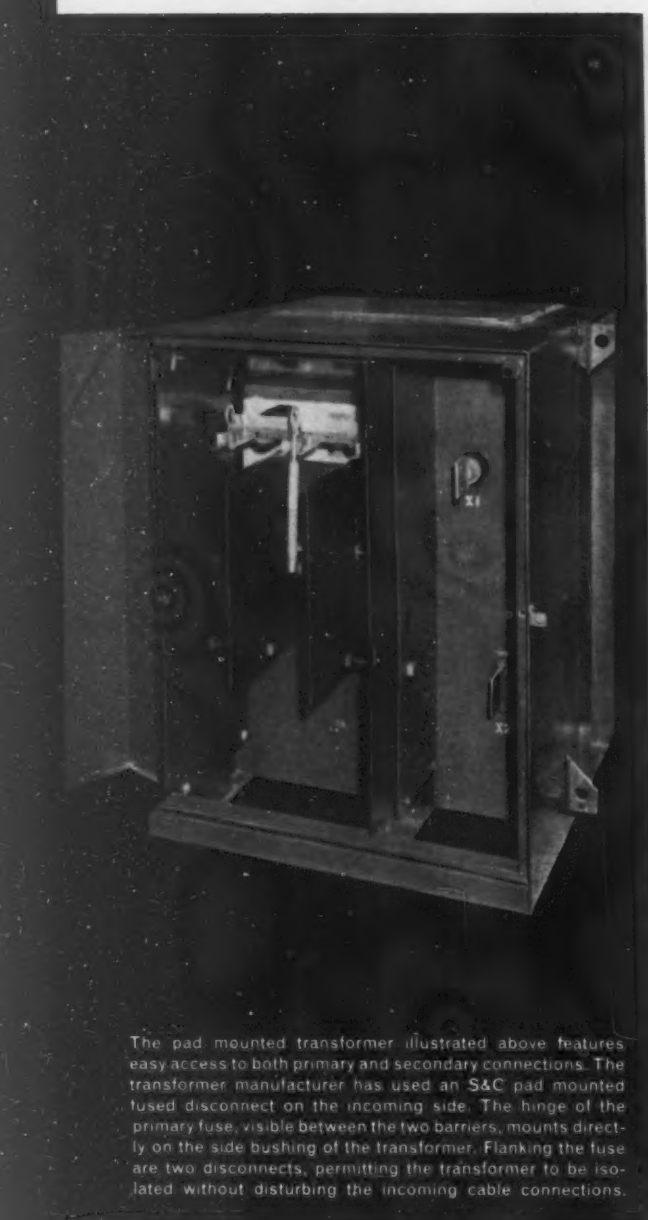
Creative Engineering for Fluid Systems

Henry Pratt Company, 319 West Van Buren Street, Chicago 7, Illinois

For phone number of closest representative see advertising index in back of book.

Switch & protect residential underground circuits . . . in air

S&C's new pad mounted gear employs fuses and disconnects expressly designed for compact air-filled enclosures



The pad mounted transformer illustrated above features easy access to both primary and secondary connections. The transformer manufacturer has used an S&C pad mounted fused disconnect on the incoming side. The hinge of the primary fuse, visible between the two barriers, mounts directly on the side bushing of the transformer. Flanking the fuse are two disconnects, permitting the transformer to be isolated without disturbing the incoming cable connections.

The simplicity and practicality of overhead distribution practices are now available on residential underground circuits. "Air-filled" S&C pad mounted gear switches, protects and isolates pad mounted transformers and buried cables. It provides all these advantages, too:

1. Full load switching and fault interruption are *outside the transformer*. No arcs are drawn under oil to cause fires, "burping," contamination. External switching also means *visible air gaps*.

2. Fuse eliminates need for primary link inside transformer. Transformers needn't be untanked for re-fusing.

3. Wide choice of fuse ratings (up to 200E amperes continuous) permits close coordination, anticipates load growth.

4. Both transformers and cables can be switched. This applies to load currents, charging currents, and magnetizing currents.

5. Eliminates the hybrid combination of overhead sectionalizing with pad mounted transformers—puts your residential distribution system entirely underground.

You can order S&C pad mounted gear in almost any disconnect and fuse arrangement for sectionalizing . . . or components for transformer primary applications.

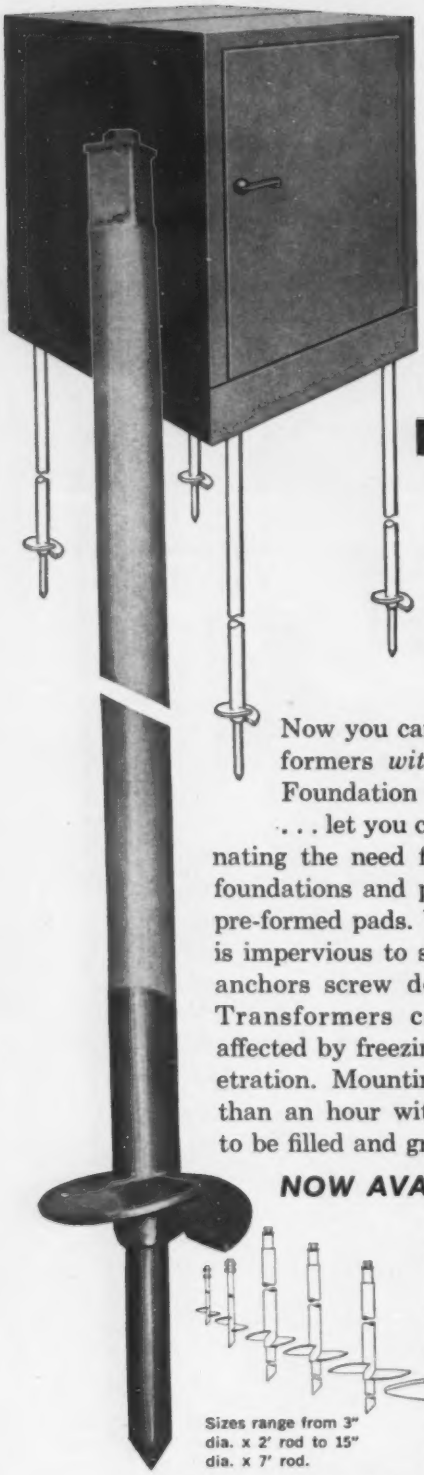
The fused disconnect above is S&C's Standard Duty Style; the disconnects are rated 200 amperes continuous (8,000 amperes momentary); the fuse is rated up to 50 amperes continuous, 8,000 amperes interrupting. With Loadbuster, the disconnects and the fuse can switch full load.

S&C ELECTRIC COMPANY
4425 Ravenswood Avenue • Chicago 40, Illinois
Specialists in High Voltage Circuit Interruption since 1911

S&C Heavy Duty Pad Mounted Fused Switching Unit shown above is a complete, free-standing device—functioning, in this case, as loop tap serving adjacent pad mounted transformer. Disconnects are rated 600 amperes continuous (25,000 amperes momentary). Power fuse is rated up to 200 amperes continuous, and 17,500 amperes interrupting.

Note how visible circuitry reduces chance of operator error. With Loadbuster, S&C's portable loadbreak tool, the operator can switch full loads—up to 400 amperes at 14.4 kv.

For phone number of closest representative see advertising index in back of book.



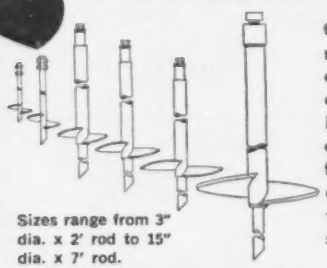
Complete mounting of "PAD-MOUNTED" TRANSFORMERS in less than an hour with

CHANCE FOUNDATION ANCHORS

- *No Concrete pads to pour or handle*
- *No Delays for grading*

Now you can install pad-mounted transformers *without concrete pads*. Chance Foundation Anchors make this possible . . . let you cut installation time by eliminating the need for special excavations, rock foundations and pouring concrete or handling pre-formed pads. You get a "foundation" that is impervious to seasonal changes because the anchors screw down below the frost level. Transformers can't move . . . they aren't affected by freezing, thawing, or moisture penetration. Mounting can be completed in less than an hour without waiting for the trench to be filled and graded.

NOW AVAILABLE IN SIX SIZES



Sizes range from 3" dia. x 2' rod to 15" dia. x 7' rod.

Chance Foundation Anchors now come in six sizes to accommodate a wider range of transformers — up to the BIG ones — and for a variety of applications, such as foundations for tool sheds, air conditioners, shelter houses, whatever your ingenuity can suggest.

Write for a detailed bulletin that shows how Chance Anchors can help you save time in the installation of surface-mounted transformers.

A. B. CHANCE COMPANY
CENTRALIA, MISSOURI
(A. B. Chance Company of Canada, Ltd., Toronto) CAS1-8A

Electric in 1939 as secretary and seven years later became president and chairman of the board. He resigned as president last December. He participated in many business, community and cultural activities. In 1957 he was named Canadian Businessman of the Year; in 1958 was presented with a Human Relations Award by the Canadian Council of Christians and Jews. He also had received the B. C. Newsmen's Club Man of the Year award.

► **Robert L. Sawyier** Jr. has been appointed director of commercial sales for Pacific Gas and Electric Co., succeeding **Stanley O. Blois,** who was recently named Colgate Division commercial manager in Marysville. Sawyier is a specialist in commercial and industrial lighting and has been PG and E's chief illuminating engineer since 1958. A naval aviator during World War II, he holds a commercial pilot's license.

► **Jack N. O'Neal** has been made Portland area manager for Bonneville Power Administration. With BPA since June 1949, he has been customer service officer in the Portland area since 1955. Previously he served in power management, system development and service programming, receiving four outstanding performance awards.

O'Neal

► **Ralph Millsap,** PGE vice president, has been elected treasurer of Associated Oregon Industries, a state-wide association of business and industrial firms.

► **P. J. Kalamarides** has replaced **Paul Rohwer** as representative of Alaska systems on the board of trustees of the Northwest Public Power Assn. Both men are with the Chugach Electric Assn. at Anchorage.

► **Kinsey M. Robinson,** chief executive officer of Washington Water Power Co., was presented with an honorary doctor of laws degree from the College of Idaho at Caldwell.

► **Curt Taylor** has been made operations superintendent for Inland Power & Light Co. at Spokane.

► **Kemil Satir,** a native of Turkey, has joined the staff of Inland Power & Light Co. as engineer.

► **Douglas C. White** has been transferred from Portland to Salem as superintendent of Portland General Electric Co.'s Willamette Valley Division. He replaces the late Larry Flagg. White had been distribution engineer for the utility at Portland. He joined PGE in 1946 as an assistant engineer in the distribution department and in 1956 was named assistant superintendent of outside divisions. His Portland post is being taken over by **Eric Verheiden** who will serve under the title of engineering assistant to the general division manager.

White

► **Edward L. Bowen** has been named by Utah Power & Light Co. to succeed the late W. E. Dunbar as dealer sales consultant in the Preston sales and marketing department. Bowen has been with the company since April 1946 and was first employed as a maintenance helper, dam attendant and relief operator at the Cutler hydroelectric plant. Since 1958 he has been in the Preston division as consultant in the sales and marketing department.

► **U. V. Engstrom** has been appointed resident construction engineer for Wanapum Dam project on the Columbia, replacing **R. B. Jackson.** Jackson was transferred to the main office of the Harza Engineering Co. in Chicago where he will assume duties of chief construction engineer, covering various Harza projects over the world. He will retain general direction of Priest Rapids Dam being built 18 miles downstream from Wanapum for Grant County PUD. Engstrom has had 30 years of experience in the hydroelectric field, including 20 years with the USBR.

► **Jonel C. Hill,** Oregon Public Utilities commissioner, has been appointed a member of the executive committee of the National Association of Railroad & Utilities Commissioners, succeeding George E. Hill of Michigan.

► **Fred Kempe,** director of public relations and advertising for Portland General Electric Co., has been made chairman of the public relations committee for the United Good Neighbors campaign in Portland.

► **Emmet P. Kelly** has been promoted from assistant manager of operations to general manager, operations and engineering, for Puget Sound Power & Light Co. He started with the company in 1929 as a student engineer after graduation from the University of Washington. In addition to serving as assistant manager of operations and safety director, he has been plant protection officer and coordinator of civil defense. **John E. Makovich** was named director of safety, to take over Kelly's former duties. Makovich had been assistant superintendent of light and power since 1959.

► **C. C. Davis,** chief of the construction division, Walla Walla District of the U. S. Army Engineers, retired recently. He had been with the Corps for 34 years, having started in the Galveston district following his graduation from Texas A & M. His first post in the West was as assistant superintendent of construction on the Fort Peck project in Montana. He later was transferred to the Portland district and during World War II served overseas.

► **Ferol E. Betz** has been named industrial relations manager for Puget Sound Power & Light Co. with offices in Bellevue. He joined the company on Aug. 1 after nine years with General Electric, where he had been manager of employee and community relations for the aircraft nuclear propulsion division at Idaho Falls. A former college instructor, he received a bachelor of arts degree in economics and social science from Ohio University.

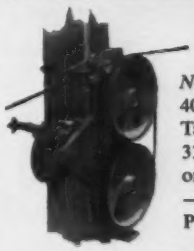
Betz

► **L. J. Schultz** has been named general manager of the Chugach Electric Assn., succeeding Erling Orwoll. He had been general manager of the Grand Electric Cooperative of Bison, N. D., and was recommended to the Anchorage association by the REA and the National Rural Electric Cooperative Assn.

► **David H. Meldrum,** former chief of the military construction branch, North Pacific Army Engineer Division, has been assigned to Honolulu where he will be chief of construction for the Pacific Ocean Army Engineer Division.

NEW

PENGO POLE-MOUNT TENSIONER



Now...PENGO 4000 Tensioner Takes Conductor to 336,500 cm-ACSR or 397,500 cm-AAC —Tensions to 1,000 Pounds!

Here's a bullwheel tensioner you can carry in every line truck! It features two 18 inch neoprene lined bullwheels. Tru-Stop disc brake—yet weighs so little it's truly portable.

Two men can easily place the 4000 PM against the pole, attach it (chains and wing-nut tightener are permanently attached to tensioner), and start stringing in a matter of minutes. Conductor can be payed off any suitable reel stand. A collapsible reel attached to a winch shaft makes a practical puller, although any type of power previously used for pulling can be used.

TENSION WIRE STRINGING is the safe, economical modern way to string distribution and transmission lines. Why not get the facts? Write for new PENGO catalog TSE-1 for full data on the world's largest, most complete line of tension stringing equipment. Please address Dept. 34.

PETERSEN ENGINEERING CO., INC.

460 Kifer Road
Santa Clara, California
Phone: AXminster 6-7712

B-15

THIS GENERAL ELECTRIC BOILING WATER REACTOR PLANT is conventional in appearance, economical in certain high-fuel-cost areas.

A FULL LINE OF NUCLEAR PLANTS TO 500,000 KWE

General Electric BWR plant cost equals conventional plant cost in certain areas

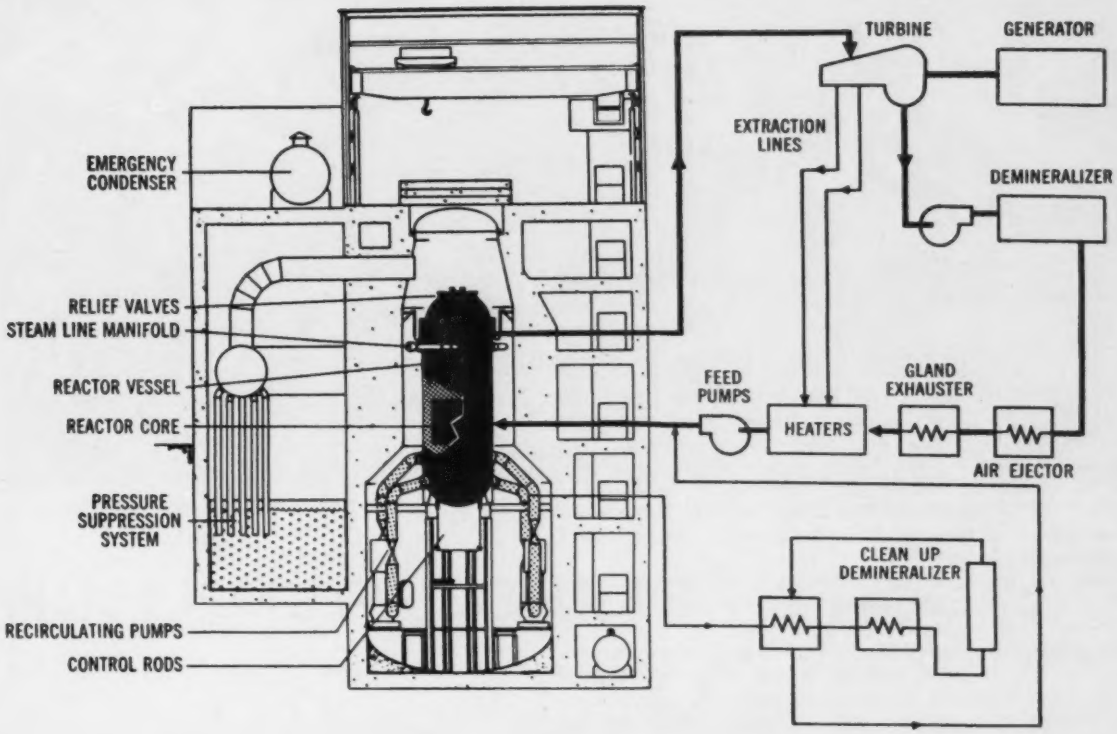
General Electric is now offering a full line of boiling water reactor nuclear power plants rated up to 500,000 kwe. These new plants will be competitive with, or more economical than, conventional plants in certain high-fuel-cost areas.

These advanced designs are now possible because of information from testing and operation of Commonwealth Edison's Dresden Nuclear Power Station, and other results from continuing technical development programs with electric utilities and the Atomic Energy Commission.

Dresden has demonstrated BWR stability, simplicity of operation and control, and ease of maintenance. Technical

General Electric
Nuclear Technology Helps
Keep Power Costs Low

Dresden—
Large Boiling
Water Reactor Feasibility
(Commonwealth Edison Co.)



COMPACT REACTOR SYSTEM arrangement and pressure suppression containment for single-cycle boiling water reactor plants reduces capital cost, simplifies construction. Pressure suppression was developed by General Electric in conjunction with Pacific Gas and Electric Co. for the Humboldt Bay Plant Nuclear Unit. It will also be applied at PG&E's recently announced 325-mwe Badega Bay Nuclear Power Plant.

development program results include pressure suppression containment, steam separation within the reactor vessel, higher core power density, and significant increases in plant rating.

Research and development work is continuing to further reduce the costs of boiling water nuclear plants—projects on fuel design, higher core power density, materials, equipment compaction, and nuclear superheat.

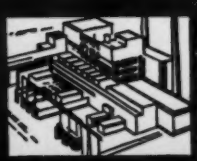
For more information on General Electric commercial atomic activities, contact your nearby G-E Sales Office or write to General Electric Company, One River Road, Schenectady, N. Y. Outside the United States and Canada, contact International General Electric Company, 150 East 42nd St., New York, N. Y. 132-11

BWR PLANT SPECIFICATIONS

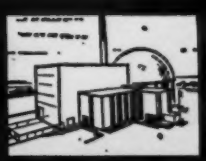
	Natural Circulation	Forced Circulation			
		Single Cycle	Single Cycle	Single Cycle	Dual Cycle
Generator Output (Mwe)	100	200	303	405	500
Net Plant Output (Mwe)	96	191	289	387	481
Reactor Thermal Power (Mwt)	330	618	935	1240	1600
Sat. Steam Pressure at Turbine (psia)	975	1035	1035	1035	pri. .965 sec. .475
Containment System	Pres. Supp.	Pres. Supp.	Pres. Supp.	Pres. Supp.	Sphere

Progress Is Our Most Important Product

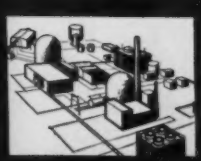
GENERAL ELECTRIC



Humboldt Bay—
Natural Circulation,
Pressure Suppression
(Pacific Gas &
Electric Co.)



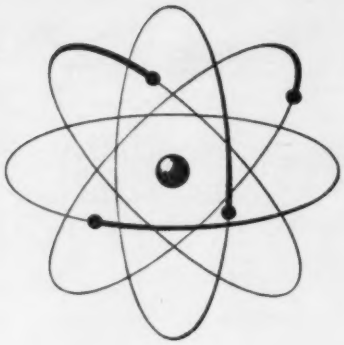
Big Rock—
High Power Density
(Consumers
Power Co.)



EVESR—
Nuclear Superheat
(Empire State Atomic
Development Associates)

ELECTRICAL WEST

VOL. 127, NO. 3 SEPTEMBER 1961



. . . . WITH FAINT PRAISE

TEN YEARS AGO, it became possible for private industry to take part in the development of nuclear energy for the production of electric power. At that time there was much talk of the urgency for the U. S. to push forward in this work. We must not—so the word went—allow Russia to offer atomic power abroad before us. By developing this resource, we would enable the energy-poor countries of the world to raise their living standards. We would set the cornerstone for new industrial nations. We would carve another notch for Western technology.

All that was needed was to turn a bomb into a boiler. Then get the cost of the power output in line with fossil fuel plants. That was ten years ago.

With plants announced and abuilding where costs are competitive with conventional fuels, much of the original goal has been achieved. Regrettably however, our nuclear power accomplishments are not of much pride to our national leaders. They hasten to point out that we have fallen behind Russia in transmission. And we must press ever forward with hydro starts or who knows what the Hottentots will think.

But most of all, we are too busy wearing ashes and sackcloth over our missile failures to recognize our nuclear successes. We cannot refrain here from contrasting the sad record of our government-directed space effort with the steady progress of industry in seeking competitive nuclear power.

Three key scientific breakthroughs grew out of World War II: the jet engine, the controlled atom and modern rocketry. Today the preponderance of world airlines fly jets produced by American business. Our nuclear power know-how is second to none. Only where government has dominated must we accept second best.

In the face of nuclear achievement, our administration—particularly those who should be most proud—great accomplishment with contempt and abuse. Their political motives are clear. Theirs is an effort to discredit, to mute the works of private business in the hope that they can bring about their party's goals of federally generated atomic power. However unfair, this is politically understandable.

The unconscionable aspect is that men in high places are more willing to recognize the scientific progress of our communist enemy than the progress that springs from the effort of free men. Surely we lend support to the enemy when we are blind to our own strengths.

The thought runs deeper. As much as our missiles and our bombs, Mr. K fears our ability to produce. In America, in Western Germany, in every free country, we win each day a battle for peace because free men, competitively motivated, will out-produce any people motivated by fear.

An administration that fails to understand the peace power of American industry, regulated but unharassed, will have difficulty keeping world peace by force of arms alone.

Research and development facilities, such as the one shown above of General Atomics, play a dominate role in Western nucleonics

NUCLEAR PROGRESS — PROGNOSIS

The Western nuclear power industry from your point of view

HUGH JAMES, ENGINEERING EDITOR, ELECTRICAL WEST

IN THIS ISSUE the editors present the past performance, progress and prognosis for the nuclear power industry in the West.

A look at the accompanying map will show the number of reactors in the West. The map also shows the extent of the uranium deposits in the U. S. (practically all within the bounds of 11 Western states). The roster of the American Nuclear Society shows an outsized segment of this scientific community harbored here in the West where Dr. Lawrence did much of the basic work for the atomic age. The research facilities, the manufacturing plants, the centers of basic nuclear physics, combine to make the West the heart of the nuclear power industry.

Progress

The United States is the world's largest producer of uranium, producing 8,000,000 tons in 1960—an all-time high. More than 97% of this ore was mined in 11 Western states for which mine owners were paid approximately $150 million.

Domestic ore reserves are now estimated at around 82 million tons—some 96% of these reserves being located in the West. While these reserves represent only a 10-year supply at the 1960 mining rate, it is expected that further exploration and refinement in mining and extraction techniques will make a substantial increase.

During 1960, 25 domestic uranium mills were processing uranium for the AEC at the rate of 22,100 tons per day. These mills are all privately owned and operated. Twenty-four are in the West, representing a capital investment of $140 million and processing 21,700 tons per day in 1960.

At the present time some 38 companies are manufacturing fuel elements in the U.S., including the Hanford works of the AEC which does some fabrication. As long as this country follows the approach of developing many different types of reactors simultaneously, there will be an attendant need for many different types of fuel. It appears that the use of a standard fuel element is a long way off.

Power Plants

Of special interest are the reactor plants. Of the 154 power reactors built or building in the U. S., 54 are in the West and 26 have generating capabilities in excess of 2,500 kw. Eleven of these plants are being installed or designed in the West and represent an investment of more than $266 million, of which $177 million have been or will be supplied by private industry.

In summary, the picture of the nuclear power program in the West shapes up as follows:

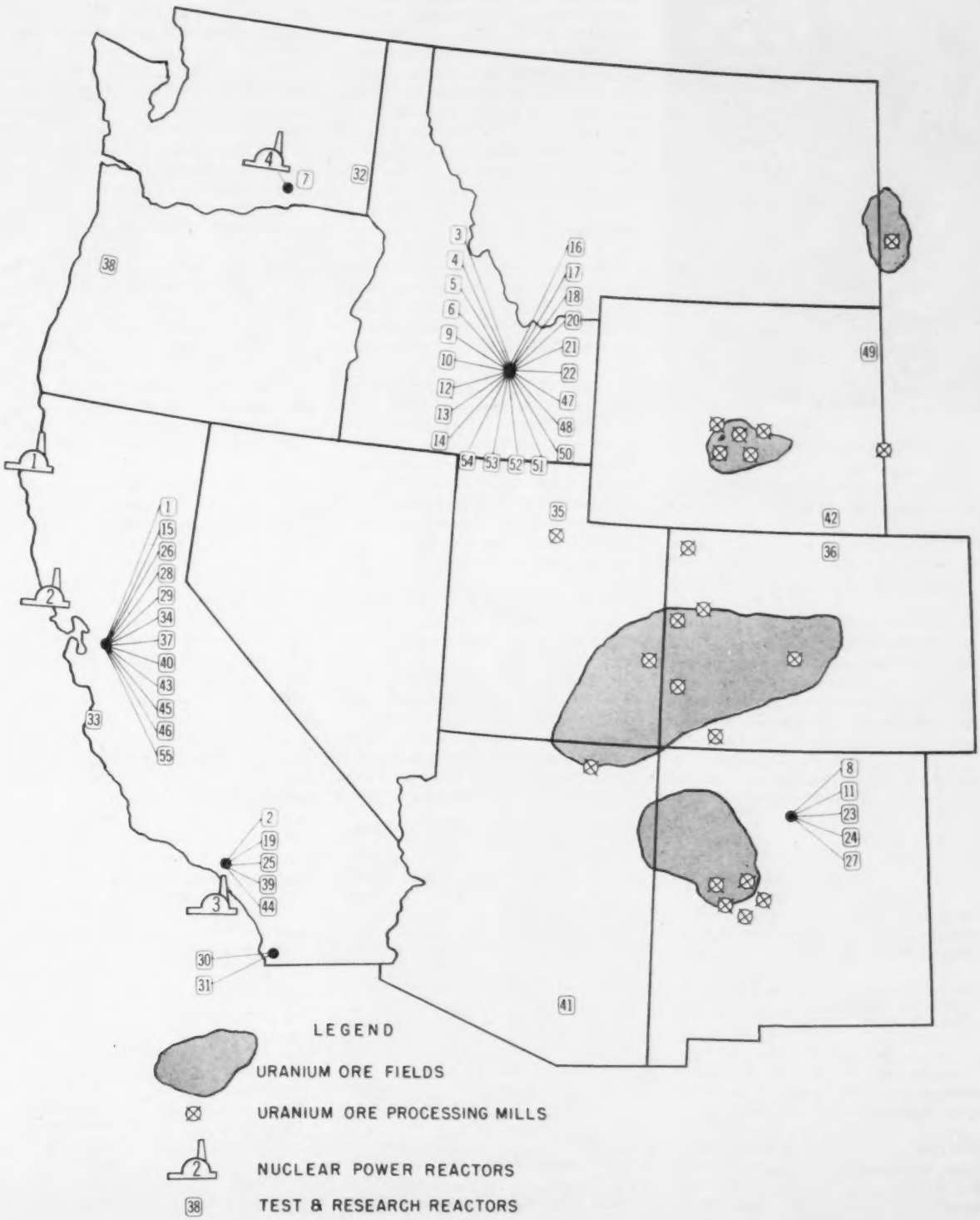
1. 97% of uranium mining and reserves
2. 96% of uranium mills
3. 54 nuclear reactors with a combined generating capacity of 403,650 kw
4. Five other large nuclear reactors with a combined generating capacity of 356,400 kw were or are being designed in the West
5. Some of the world's foremost laboratories are located here, including: Los Alamos Scientific Lab, Lawrence Radiation Lab, Hanford Lab, General Electric Co., Atomics International Division of North American Aviation, Aerojet General/Nucleonics, General Atomic Division of General Dynamics Corp., American-Standard Corp.

(Continued on page 72)

WESTERN REACTORS (Built, Building, Planned)

NAME AND/OR OWNER	LOCATION	PRINCIPAL NUCLEAR CONTRACTOR	TYPE	POWER KW	START-UP
A. POWER REACTORS					
1. Humboldt Bay Unit No. 3 (PG and E)	Humboldt Bay, Calif.	G-E	Boiling water	48,500 (e)	1962
2. Bodega Bay Unit No. 1 (PG and E)	Bodega Bay, Calif.	G-E	Boiling water	325,000 (e)	1965
3. Southern California Edison	Los Angeles Area	W	Pressurized water	360,000 (e)	planned
4. New production reactor (AEC)	Hanford, Wash.	G-E	Graphite moderated	700,000 (e)	planned
B. EXPERIMENTAL REACTORS					
1. Vallecitos (PG and E & G-E)	Pleasanton, Calif.	G-E	Boiling water	5,000 (e)	1957
2. AEC & Southern Calif. Edison	Santa Susana, Calif.	AI	Sodium graphite	6,000 (e)	1957
3. Breeder Reactor No. 2 (AEC)	Idaho	Argonne	Fast breeder	16,500 (e)	1961
4. Boiling Reactor No. 5 (AEC)	Idaho	Argonne	Boiling water	2,650 (e)	1961
5. Breeder Reactor No. 1 (AEC)	Idaho	Argonne	Fast breeder	150 (e)	1951
6. Organic moderated (AEC)	Idaho	AI	Organic cooled and moderated	5,000-15,000 (t)	1957
7. Plutonium recycle (AEC)	Hanford, Wash.	G-E	Heavy water moderated and cooled	70,000 (t)	1960
8. Molten plutonium (AEC)	Los Alamos, N. M.	Los Alamos	Fast molten plutonium cooled	1,000 (t)	1961
9. Organic cooled (AEC)	Idaho	AI & Phillips Petroleum	Organic	40,000 (t)	1962
10. Beryllium oxide (AEC)	Idaho	General Atomic	Gas cooled BeO moderated	10,000 (t)	1962
11. High temperature (AEC)	Los Alamos, N. M.	Los Alamos	Gas cooled	3,000 (t)	1962
12. Materials testing (AEC)	Idaho	Blaw-Knox	Tank	40,000 (t)	1952
13. Engineering test (AEC)	Idaho	Kaiser	Tank	175,000 (t)	1957
14. Advanced test (AEC)	Idaho	Ebasco & B&W	Tank	250,000 (t)	1964
15. G-E Materials Test Reactor	Pleasanton, Calif.	G-E	Tank	30,000 (t)	1958
16. Special test No. 1 (AEC)	Idaho	Phillips Petroleum	Open tank	Transient	1955
17. Special test No. 2 (AEC)	Idaho	Phillips Petroleum	Pressurized water	Transient	1960
18. Special test No. 3 (AEC)	Idaho	Phillips Petroleum	Pressurized water		1958
19. Kinetic test (AEC)	Santa Susana, Calif.	AI	Homogeneous	50 (t)	1956
20. Transient test (AEC)	Idaho	Argonne	Graphite	100 (t)	1959
21. Fast source (AEC)	Idaho	Argonne	Fast	1 (t)	1959
22. Special power excursion test No. 4 (AEC)	Idaho	Phillips Petroleum	Pool	Transient	1961
23. Fast reactor (AEC)	Los Alamos, N. M.	Los Alamos	Homogeneous	25 (t)	1950
24. Water boiler (AEC)	Los Alamos, N. M.	Los Alamos	Fast, plutonium fuel, mercury cooled	25 (t)	1946
25. North American Aviation water boiler neutron source (AEC)	Santa Susana, Calif.	AI	Homogeneous	2 (t)	1952
26. Water boiler (AEC)	Livermore, Calif.	AI	Homogeneous	0.5 (t)	1953
27. Omega West (AEC)	Los Alamos, N. M.	Los Alamos	Tank	5,000 (t)	1956
28. G-E Test Reactor	Pleasanton, Calif.	G-E	Light water	30 (t)	1957
29. Pool type (AEC)	Livermore, Calif.	Foster Wheeler	Tank	2,000 (t)	1957
30. General Dynamics (TRIGA)	San Diego, Calif.	General Atomic	U-Zr hydride, tank	250 (t)	1958
31. General Dynamics (TRIGA-MK F)	San Diego, Calif.	Owner	U-Zr hydride, tank	1,000 (t)	1960
32. Washington State University	Pullman, Wash.	G-E	Pool	100 (t)	1961
33. Post Graduate School (USN)	Monterey, Calif.	Argonne	Homogeneous solid		1956
34. Aerojet-General Nucleonics	San Ramon, Calif.	Argonne	Homogeneous solid		1957
35. University of Utah	Salt Lake City	Argonne	Homogeneous solid		1957
36. Colorado State University	Ft. Collins, Colo.	Argonne	Homogeneous solid		1957
37. University of California	Berkeley, Calif.	Argonne	Homogeneous solid		1957
38. Oregon State College	Corvallis, Ore.	Argonne	Homogeneous solid		1958
39. Atomics International	Canoga Park, Calif.	AI	Homogeneous		1958
40. American Radiator & Standard Sanitary Corp.	Mountain View, Calif.	Owner	Graphite/water		1960
41. University of Arizona	Tucson, Ariz.	General Atomic	U-Zr hydride, tank	10 (t)	1958
42. University of Wyoming	Laramie, Wyo.	AI	Homogeneous		1959
43. Stanford University	Palo Alto, Calif.	G-E	Pool	10 (t)	1959
44. University of California	Los Angeles, Calif.	AMF Atomics	Graphite/water	10 (t)	1960
45. Aerojet-General Nucleonics	San Ramon, Calif.	Argonne	Homogeneous solid		1961-62
46. Aerojet-General Nucleonics	San Ramon, Calif.	Argonne	Homogeneous solid, pool		1961-62
47. Stationary low power plant No. 1 (AEC)	Idaho	Argonne & Combustion Engineering	Boiling water	200 (e)	1958
48. Gas cooled (AEC)	Idaho	Aero-General	Gas cooled		1960
49. Portable medium power plant No. 1 (USAF-AEC)	Sundance, Wyo.	Martin	Pressurized water	1,000 (e)	1961
50. Mobile low power plant No. 1 (AEC)	Idaho	Aerojet-General	Gas cooled	300-500 (e)	1961
51. Military compact pilot plant (AEC)	Idaho	Nuclear Development		Up to 3,000 (e)	1962
52. S-1 facility (AEC)	Idaho	W	Pressurized water		1953
53. Large ship prototype (AEC)	Idaho	W	Pressurized water		1958
54. Shield test facility (AEC)	Idaho	G-E (ANPD)	Pool	10-100 (t)	1959
55. G-E ESADA	Pleasanton, Calif.	G-E	Nuclear Superheat	12,500 (t)	1962

With four power producers, 55 experimental, test or research reactors, the major U. S. uranium deposits and 96% of the ore mills, the West is rapidly becoming the center of atomic activity



General Electric engineers work out fuel-handling methods for superheat reactor

6. The AEC investment in the West amounts to $1.8 billion and will increase to $2.3 billion with the completion of presently authorized construction.

7. Private investment in nuclear facilities is hard to assess but it is estimated to be in excess of $300 million.

Now comes the recent announcement of PG and E's Bodega Bay Nuclear Park and its belief that the first station, to be rated 325 mw, will be only the forerunner of many more to come to that location in the not too distant future.

Last year Southern California Edison announced that it would build the world's largest atomic electric power plant—360 mw. The announcement stated that the plant would be designed and built by Westinghouse and that Bechtel Corp. would be the engineering constructor. The over-all plant cost was estimated at $70 million.

At press time, Southern California Edison was still negotiating with the government for permission to build the plant at Camp Pendleton. No decision had been reached and the company said that the go-ahead on the plant was tied up in site negotiations.

This Issue

This issue runs the gamut from basic nucleonics to the laboratory. Our approach has been to gain a view of the industry from the viewpoint of the ELECTRICAL WEST reader. Thus we have sought the articles and asked the questions we think you want answered. Here's the line up.

We asked each of five manufacturers to bring us up to date on five of the most promising types of nuclear reactors—the boiling water reactor, the pressurized reactor, the sodium graphite reactor, the organic moderated reactor, and the high temperature gas-cooled reactor. Then, Babcock & Wilson presents in the New Products Section a story on its Spectral Shift Control Reactor, which is moderated with a mixture of heavy and light water.

R. H. Graham consented to do a piece for us on the nuclear fuel cycle. And, though based on the General Electric Co. concept of fuel fabrication, much of the information should be applicable to other forms.

Containment of reactors is a real pressing problem now. Much work is being done and will be done to cut the cost of this portion of nuclear power plants in order to make them more competitive. Pacific Gas and Electric Co. came up with Pressure Suspension for its Humboldt and Bodega Bay plants and C. H. Robbins of General Electric and D. B. Barton of PG and E have given us the story of this important development.

Waste—a nuisance in any form of business—becomes a real problem in a nuclear plant if not attacked properly. J. S. Corbett, chief radiation protection office, Nuclear Engineering Co., tells us how nuclear waste contractors have developed means of removing the waste problem from the routine operations of the power plant.

We have taken a quick look at the fusion picture and have given what answers we could find regarding when we might look forward to the use of this "energy of the stars."

Dr. R. W. Pidd, manager of direct conversion program, General Atomic, discussed with us some of the possible applications of direct conversion schemes in the electric power field.

We think our readers in the operating end of the power plant business will enjoy the section on licensing procedures for nuclear power station operating personnel prepared by H. L. Price, acting director of regulation, AEC. Also, we asked industry leaders to tell us their opinions on where we have been and where we are headed in the nuclear power program. And, finally, we wind up with our evaluation of where we go from here.

The preparation of this issue has been a consuming and rewarding task. We hope you find it enjoyable and profitable reading.

Civilian Power Reactors Being Designed in the West for Installation in Other Areas

Name	Dresden	Big Rock Point	Sheldon Station	Piqua	Peach Bottom
Location	Morris, Ill.	Charlevoix, Mich.	Hallam, Neb.	Piqua, Ohio	Peach Bottom, Pa.
Owner of Reactor	Commonwealth Edison	Consumers Power Co.	Atomic Energy Commission	Atomic Energy Commission	Philadelphia Electric Co.
Owner of Electric Generating Capacity	Commonwealth Edison	Consumers Power Co.	Consumers Public District	City of Piqua	Philadelphia Electric Co.
Principal Nuclear Contractor	General Electric	General Electric	Atomics International	Atomics International	General Atomic
Reactor Thermal Capacity (kw)	626,000	240,000	254,000	45,500	115,000
Electric Capacity (kw)	180,000	50,000	75,000	11,400	40,000
Reactor Type	Boiling water	Boiling water	Sodium graphite	Organic cooled and moderated	High temperature gas-cooled
Total Cost	$36,300,000	$30,000,000	$45,000,000	$11,800,000	$24,500,000
Private Investment	$36,300,000	$30,000,000			$24,500,000
Start Up	1959	1962	1962	1961	1963
Status	Operating	Under construction	Under construction	Under construction	Design

BODEGA—ECONOMIC POWER

A Chat with Norm Sutherland—the "mysteries" of Bodega Park

"YOU WANT TO KNOW the story behind the Bogeda Bay economics, don't you?" The interview was getting off to a good start.

"Well, since you volunteered . . ."

There was a pause for a starting place. "Several years ago at the time we announced the Humboldt project, the same doubting questions were asked. We were, in some cases, politely accused of not knowing what we were talking about. Some skeptics said that we had neglected to include taxes and insurance during construction—all kinds of things. That's all quieted down now. We just don't do business that way, but probably there will always be doubters . . .

"Back at the time of Humboldt, we revealed our best estimates of the energy and capacity requirements for the PG and E system for the years through 1975. Relating these demands to fossil fuel requirements clearly documents the point that any energy source that competes favorably with $3/bbl oil deserves searching attention. Such a promise for nuclear power grew out of our earliest studies.

"This promise led us to join with General Electric to build Vallecitos. It led us to commit ourselves to Humboldt. With each step in our own experience and with the experience of others from within and without our utility industry, we have gained knowledge—and, with knowledge, the ability to reduce costs. For example, our pressure suppression development is one device that does just that.

"Our motive is and has been supplying low cost power in ever-increasing quantities against a base of ever-increasing fuel and construction costs.

"This same motive has led us to Bodega Park. Economic studies show it to be a prudent investment. That's painfully uncomplicated, isn't it?" he challenged . . .

"We simply are going ahead because it's economic.

"Now let's talk about mill-splitting. With our long-term problem of low cost energy supply becoming more acute each year, we have to be willing to assume some small risk that we will not do as well as we plan in the interest of learning and being ready for the future. On the other hand, we might do a lot better. Mind you, our estimates are as realistic as we can make them. It's just that in a young science, there must be margin for error.

"While it is true that Bodega Bay is somewhat farther from load center than we have been building conventional Bay Area plants, our studies show us the site anticipates load center changes. We acquired the site still undecided about conventional or nuclear, but we've known for more than two years that we would need a North Bay plant by 1966. But this is a small factor, and it doesn't affect our announced costs.

"Our figures are real and our motives are public and uncomplicated. Why then, we are asked, don't we give detailed cost breakdowns for our questioners? Well, we view Bodega and Humboldt as normal system additions. We expect them to function like power stations, not laboratories or curiosities. So we have disciplined ourselves to think of nuclear stations as the kind of thing we might be doing regularly. Only in this context do you really get the feel of the cost of nuclear power. Therefore, we haven't done anything more with our nuclear cost breakdown than we would for a conventional plant. The facts and figures are all being prepared for the PUC and when they are presented they will become public domain and any and all are welcome to look them over for the cost elements. We just don't want to enter into a lot of time consuming academic discussions on economics at this time. This is our normal way, that's all."

N. L. Sutherland, president of PG and E

"Is there another nuclear plant for PG and E in the near future?"

"Certainly not until we have Humboldt on the line, and a good idea of how operating results compare with our design estimates. Probably we won't add any other nuclear units until Bodega is on the line.

"There are lots of people sitting on the fence, or in the final stages of negotiations. With each new plant there is more confidence, and with each completed plant, more knowledge and proof of the promising role of this new power source. The intervening years will bring a variety of worthwhile developments . . . A second unit at Bodega probably would be radically different from today's design. I'd be surprised if it weren't.

"We've been in the atomic business for 10 years now—ever since the beginning for utilities—and have committed $100 million to nuclear-fueled electric plant development. We've learned a lot ourselves, and also have profited from the accomplishments of other segments of the industry. We expect to continue to do so. We plan also to continue to share knowledge and experience we gain in our studies, planning, engineering and construction.

"PG and E is a large and constantly expanding utility. It builds commercial power plants, adding substantial amounts of capacity each year to serve a growing market. We've operated one nuclear plant for four years, will have another one completed next year. We joined as a partner in the Dresden and Peach Bottom projects, and now we're ready to start a third nuclear plant of our own.

"The first one, Vallecitos, was experimental. But the next two, Humboldt Bay and Bodega Bay, are commercial. They offer the best power costs at the time and place the power is needed. Nuclear power, or any other kind of generation, is no good commercially if it can't compete in the market area concerned.

"Economic power is the only kind PG and E is interested in."

NUCLEAR STEAM SUPPLY SYSTEMS

An introduction to reactor design. What reactor types lead the race for competitive power?

ALL NUCLEAR STEAM SUPPLY systems have certain things in common as the design of the system is usually based on the following considerations: the fuel; the moderator; the coolant; the control elements; and the containment.

The Fuel

The fissionable material used in most American reactors is uranium. This fuel contains U-235, the isotope capable of fissioning, which produces "excess" neutrons making a chain reaction possible. Natural uranium contains only one part U-235 to 140 parts of U-238 and American manufacturers must turn to the government to obtain supplies of enriched uranium, that is, uranium in which the percentage of U-235 has been increased.

The British have experimented almost exclusively on the high temperature graphite moderated reactors in which uranium in its natural state may be used as a fuel.

The Moderator

Neutrons released by fissioning U-235 move at very high speeds. Experiments and mathematics have shown that a chain reaction can be obtained more readily with neutrons moving at a slower speed. Therefore in a reactor, there must be a substance to reduce neutron speed. This substance, water, hydrocarbon or graphite, is called the moderator.

The Coolant

Once having created the conditions necessary for the chain reaction, the collection and transfer of the heat generated must be considered. In American reactors this is accomplished either with a direct or indirect cycle. In the direct cycle the coolant (water) is pumped through the core of the reactor and the steam generated passes directly to the turbine, the condenser, and back to the reactor. In the indirect cycle the coolant (water, gas, or organic) is pumped from the reactor through an intermediate heat exchanger where steam is generated in a secondary loop to be passed on to the turbine for power generation.

Fuel is sometimes pelletized prior to assembly into fuel rods.—General Electric photo

The Control Elements

The most sophisticated part of a nuclear reactor is the control element. These elements are fabricated from materials that absorb the excess neutrons from a chain reaction and by being inserted or withdrawn from the reactor core slow down, speed up or completely stop the reaction at the will and pleasure of the operator.

The Containment

The containment of nuclear reactors is required to prevent the spread of radioactive materials to the atmosphere and the surroundings in case of an accident. The AEC has defined a "Maximum Credible Accident" as the worst accident that they evaluate in determining whether a plant design and its location should be approved. It includes the assumption that a very improbable but serious rupture of the reactor system occurs, so that the enclosure is called upon to contain the fission products assumed to escape from the reactor.

These containers may take the shape of the large steel spheres, commonly associated with nuclear reactors, when the primary coolant is under high pressure. In low pressure systems, such as the sodium reactor, simpler containment is adequate.

Throughout the world there are many different types of reactors that may or may not lend themselves to feasible application in the electric power field. However, at the present time there appear to be five that offer relatively immediate assurance of being competitive in the opinion of the editors of ELECTRICAL WEST. These reactors are:

The Boiling Water Reactor such as Pacific Gas and Electric Co. is building at Humboldt Bay and plans to build at Bodega Bay. This reactor has an efficiency of approximately 29% with no superheat and offers low capital cost for a reactor which has had considerable experience in the United States. Its main disadvantage is that the coolant (water) is corrosive and the corrosion products pick up radioactivity and transfer it to other parts of the steam supply system.

The Pressurized Water Reactor, such as Southern California Edison Co. intends to build, has had the most experience in the United States and has a heat exchanger that does separate the slightly radioactive primary system from the turbine system.

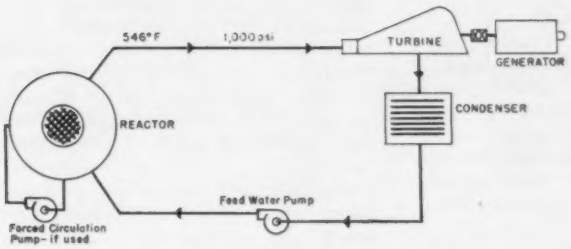
A Sodium Graphite Reactor is being built for the Hallam, Neb., nuclear power facilities. This system offers the best thermal efficiency with a minimum of containment but brings with it a high capital cost at the present state of development.

A High Temperature Gas-Cooled Reactor is being fabricated for the Philadelphia Electric Co.'s plant at Peach Bottom, Pa. This system offers good thermal efficiency (29 to 30%) with some superheat readily obtainable at low steam pressures and can use natural uranium. At the present time, it also has a fairly high capital cost.

The Organic Moderated Reactor such as the one being fabricated for the city of Piqua, Ohio, is considered. The organic moderated reactor uses a noncorrosive hydrocarbon as a coolant and an indirect cycle requiring minimum containment. The main disadvantage at the moment seems to be the breakdown of the coolant under radiation.

BOILING WATER REACTORS

GEORGE WHITE, GENERAL MANAGER, APED, GENERAL ELECTRIC CO



Fuel: Uranium
Coolant: Light water
Moderator: Light water
Key advantage: Low capital cost

Flow diagram of typical contemporary design boiling water reactor

WHEN General Electric entered the commercial atomic energy business in 1954, it looked long and hard at many reactor concepts. A nuclear study group was organized to select the reactor type which, at that time, appeared to offer the greatest promise of achieving competitive nuclear power within a decade. G-E's selection, of course, was the boiling water reactor—at that time a relatively new and untested system. Its rapid development to date, however, has confirmed the choice, and the promise indicated in 1954 appears about to become a reality.

The recent announcement by Pacific Gas and Electric Co. that a boiling water reactor will power its 325,000-kw Bodega Bay plant indicates that the boiling water reactor is now considered a reliable, efficient – and economical – power system for today's large-scale generating stations. When Bodega Bay goes on line in 1965, PG and E estimates it will produce power at 5.62 mills per kwh – cheaper than a fossil-fueled steam station in the same area.

Economics

The achievement of economical nuclear power at Bodega Bay, however, does not mean that nuclear power is now **widely** competitive. In some areas, in some ratings and under certain circumstances, BWR stations can compete with fossil-fueled plants. But further development is required before nuclear power can attain a large percentage of the power generating market.

That time, however, is not far off. The pace of reactor development has quickened perceptibly in the past two years. Since 1959, when G-E participated in an AEC-sponsored study to compare costs of reactor types, there have been significant reductions in the estimated cost of power from BWR plants. Capital costs for a 300-mwe plant have been reduced by more than 20% (over $15 million) since the 1959 study, and fuel cycle costs have been cut by one-third. In all, the reduction has amounted to about 2.5 mills per kwh.

Capital costs for the new standard BWR plant designs are now down to an estimated $197 per installed kw on a 300-mwe plant, and as low as $176 per kw on a 500-mwe station including 10% for utility site costs and interest during construction. G-E now is offering a full line of BWR plants, ranging in size from 100 to 500 mwe, at firm prime contract price and burnup. No special R&D funds are required. Development work on some features of these plants—such as high power density fuel and more compact plant layout —is still necessary, of course. These programs are now in progress and involve only areas where feasibility is well established.

Current BWR economics, which clearly indicate that the large-scale plants are now attractive in a number of high fuel cost areas of the U. S. and overseas, have not resulted from any great technological breakthroughs. Rather, they are the result of continuous design and development work performed by industry, the utilities and AEC, plus data from operating plants such as Experimental Boiling Water Reactor, Vallecitos Boiling Water Reactor and Dresden.

Technical advances and operating experience that have reduced BWR power costs are:

1. Pressure suppression containment and internal steam separation, both of which cut capital costs by permitting a more compact plant layout.
2. Better fuel fabrication techniques which permit higher burnup, thus reducing fuel cycle costs. Fuel exposure warranties are now up 50% to 15,000 mw days/ton.
3. Dresden operating data have shown BWR core power limits can be raised 25% without design changes, which means that initial fuel charges in future plants can be smaller than previously forecasted. A smaller fuel inventory permits considerable savings in fabrication cost and use charges.
4. Reduced requirements for turbine shielding, another contribution from Dresden operation, also cuts capital costs on new plants.
5. Development of high power density fuels permits use of smaller pressure vessels and other internal hardware, resulting in significant savings. The pressure vessel for today's 300-mwe plant, for example, is only slightly larger than the one used at the 180-mwe Dresden station.

Another area of cost reduction has been the recent enriched uranium price cut by the AEC. This has reduced fuel cycle costs by about 0.4 mill per kwh (assuming the $12 per gram plutonium credit remains in effect).

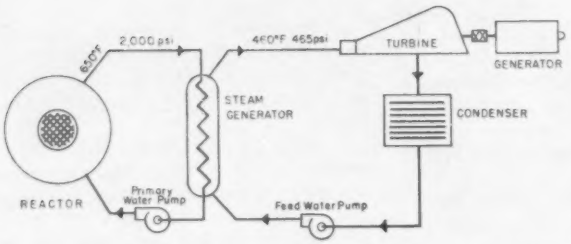
Nuclear Superheat

For the immediate future, G-E looks to nuclear superheat, more compact internal steam separation equipment, higher power density fuels, improved nuclear instrumentation and new types of fuel fabrication—such as vibrationally compact uranium oxide powder—to provide further improvements in BWR economics.

Although such improvements are expected to be more gradual over the next few years than they have been in the past two, it is believed that the BWR system has already reached a point, both technically and economically, where utilities in high fuel cost areas can give it serious consideration when planning new generating capacity.

PRESSURIZED WATER REACTORS

JAMES N. KILPATRICK, ATOMIC POWER DEPARTMENT, WESTINGHOUSE ELECTRIC CORP.



Fuel: Uranium
Coolant: Light water
Moderator: Light water
Key advantage: Most experience (in USA)

Flow diagram of typical contemporary design pressurized water reactor

With a Net Electrical Capacity of 136,000 kw, the Yankee atomic electric plant at Rowe, Mass., is a good example of the pressurized water reactor in action.

The heart of the plant is a closed cycle light water cooled and moderated reactor, using enriched UO_2 pelletized fuel encased in stainless steel. An average temperature of 514 F is maintained in the coolant, which is constantly circulated under 2,000-psig pressure. The primary coolant passes through four parallel loops to vertical steam generators and produces steam on the secondary side at approximately 467 F and 500 psi.

The expected full load turbine heat rate at 1.5 in. Hg back pressure is 11,345 Btu/kwh at 145-mw load. The average auxiliary power requirement at full load is 9,335 kw, and the expected full load station heat rate is 12,270 Btu/kwh. Although the secondary plant is designed primarily for the 145-mw rating, design margins permit a gross turbine-generator capability of 160 mw. Provision is made for complete steam dumping in the event of a generator cutout at full power.

Control

The plant is operated from a central control room in the turbine building. The reactor itself is controlled, either manually or automatically, by means of silver-indium-cadmium rods (with followers) and although this mechanical system is capable of achieving complete subcriticality of the reactor core, a supplementary chemical control system based upon boron injection is provided to insure maintenance of shutdown when the plant is cold.

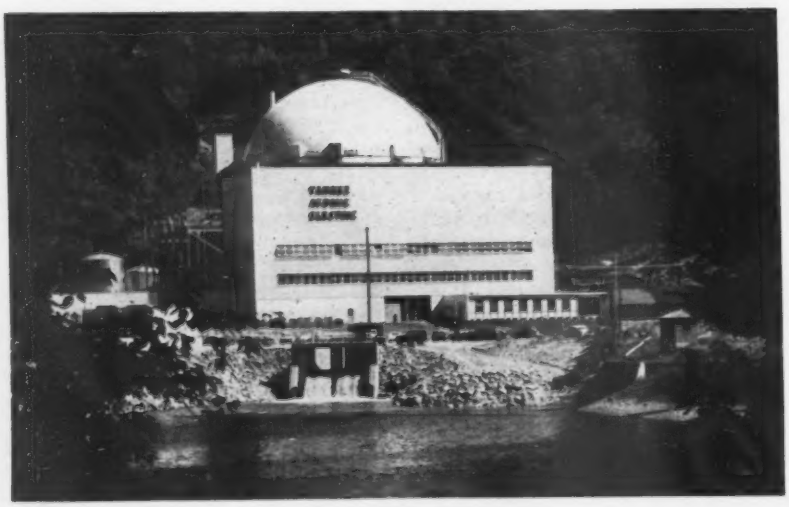
During normal shutdown, decay heat is removed by an auxiliary cooling system. The nuclear instrumentation monitors the neutron flux in the neutron shield tank surrounding the reactor vessel. This system indicates start-up rate and flux level for all power ranges, and scrams or shut down the core when the start-up rate or flux level is too high. Similarly, the reactor is shut down when a low flow or low pressure condition exists in the main coolant system. Pump failures, with ensuing decrease or loss of coolant flow, can be controlled without dangerous power or reactivity excursions. Should failure occur in a single pump, stability can be regained with practically no increase in temperature level, even without scram. In failures of two or more pumps, however, a low flow scram occurs and shuts the reactor down.

Primary Coolant Control

To preclude bulk boiling, a saturation over pressure is always maintained. Plant load changes affect the temperature of the primary coolant and, therefore, its expansion and contraction. These density changes during normal plant load changes are accommodated by the expansion and contraction of the steam volume in a pressurizer. Coolant volume changes that cannot be accommodated in this way result in the blowing of safety relief valves on the pressurizer vessel during increasing volume surges, or the scramming of the reactor during decreasing volume changes. The main coolant system is essentially a constant high pressure.

The Yankee plant will be shut down periodically for refueling, maintenance and inspection. Because those systems which contain the moderator coolant may become increasingly radioactive during plant lifetime, this contamination must be reduced where immediate access is desired. The decontamination system provides for the decontamination of isolated main coolant system loops, as well as of the pressurizer vessel.

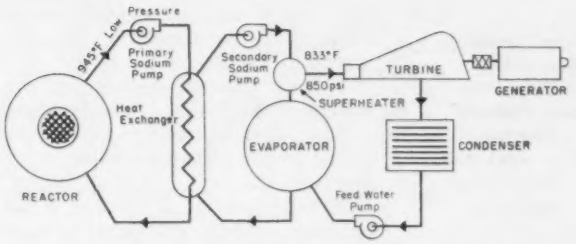
In order to refuel the reactor without hazard to personnel, facilities are provided for remote underwater removal and transfer of spent fuel assemblies from the reactor vessel to the spent fuel storage pit. Installation of new fuel assemblies is also performed remotely and under water.



The Yankee atomic electric plant is a typical example of a PWR in action

SODIUM GRAPHITE REACTORS

R. W. DICKINSON, DIRECTOR, SODIUM REACTORS, ATOMICS INTERNATIONAL



Fuel: Uranium
Coolant: Sodium
Moderator: Graphite
Key advantage: Best thermal efficiency

Flow diagram of typical contemporay design of sodium graphite reactor

SODIUM GRAPHITE reactor systems have developed from well founded engineering considerations. These are:

1. A low-pressure radioactive system to eliminate stored mechanical energy release during possible accidents and to minimize fabrication limitations in constructing extremely large (300-1,000 mwe) plants.

2. Ability to generate high-pressure, superheated steam for any modern steam turbine in order to take advantage of economics inherent in high thermal efficiency cycles.

3. Compatible core materials to eliminate release of chemical energy during possible accidents.

4. Long neutron lifetime and large thermal capacity to simplify control and protect the power generating system from effects of reactor or system power transients.

Attaining these desirable characteristics led to the selection of liquid sodium as a coolant, since its atmospheric boiling point of 1,620 F permits generation of steam at any usable temperature and pressure without exceeding atmospheric pressure over the reactor core. Graphite was selected for the moderator, because it is a solid with excellent high temperature qualities, no chemical reactivity with sodium and neutronic properties which yield neutron generation periods up to ten times as long as those in water reactors. This latter property contributes to the exceptional safety associated with sodium graphite systems which, combined with low pressure and chemical compatibility, have allowed reactors of this type of construction to omit containment shell or pressure suppression systems. Even more significant is recent, large-scale experience indicating conclusively that accidentally released fission products such as Iodine[131] are retained by the sodium, thus alleviating a major consideration in reactor site location.

The Sodium Reactor Experiment is typical of the pattern of sodium graphite reactor designs that have evolved from these principles. A 20 mw(t) reactor experiment completed by Atomics International for the Atomic Energy Commission in 1957, the SRE heats its sodium coolant to 960 F. Steam at 600 psi, 825 F is produced in the Southern California Edison experimental steam station, generating up to 7,500 kw in a conventional superheated steam turbogenerator plant. Over 15 million kwh have been so produced, and on occasion 1,000 F steam has been generated.

The Hallam Nuclear Power Facility, being constructed for the AEC to supply steam to a 75-mwe (net) power station operated by the Consumers Public Power District of Nebraska, is a direct application of SRE technology to a larger plant. Differing from the SRE primarily in power capacity and engineering detail, it will generate steam at 800 psig, 825 F on startup in 1962, with a potential capacity of 86 mwe (net) when the design capabilities of the plant are explored during operation. Atomics International is responsible for the nuclear portion of the plant.

Based on development of uranium monocarbides as a fuel, and advances in steam generator and sodium technology in a national AEC sponsored program, a 349-mwe (net), 360-mwe (gross) power plant can now be offered for construction in 1963, with a contract price of about $175/kw, and a fuel cycle cost of about 1.6 mills/kwh. Total power generating costs will vary from one utility to another, depending on financing, customer indirect charges, etc., but will be in the neighborhood of 6 mills/kwh for a typical investor-owned utility system. This plant will generate power from 2,400-psia, 1,050 F steam with reheat at 1,000 F, and a net plant heat rate of 7,980 Btu/kwh. The plant safeguard features do not differ significantly from previous SGR plants, indicating that location at desirable load distribution centers is practicable.

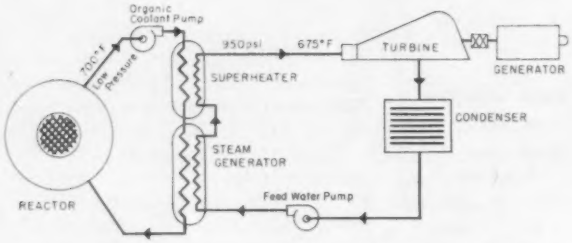
Another sodium program that offers promise for economic nuclear power is the Advanced Epithermal Thorium Reactor (AETR) project being carried on by Atomics International for the Southwest Atomic Energy Associates. This concept contemplates use of sodium as a coolant, thorium-uranium alloy as fuel and beryllium or graphite as a moderator.

Extension of power capacity beyond 360 mwe to 500-1,000 mwe presents no apparent fabrication or nuclear limitations in this low-pressure, high-temperature system; whenever larger nuclear power plants are demanded by their economics.

Sodium reactor experiment, right, produces steam for the Edison plant on the left

ORGANIC COOLED REACTORS

R. K. WINKLEBLACK, DIRECTOR, ORGANIC REACTORS DEPARTMENT, ATOMICS INTERNATIONAL



Fuel: Uranium
Coolant: Terphenyl
Moderator: Terphenyl
Key advantage: Noncorrosive coolant

Flow diagram of typical contemporary design organic cooled reactor

AN ORGANIC REACTOR is a nuclear power system in which the heat produced by fissioning of uranium is picked up by an organic liquid flowing over the heat transfer surfaces of uranium containing fuel assemblies. This hot, oil-like liquid then flows to a heat exchanger where its heat is transferred to water in the evaporator section and to steam in the superheater section. This steam is used in a conventional turbine. The organic is a mixture of polyphenyls, which are compounds of hydrogen and carbon, made from benzene. It is a clean flaky wax that is solid at room temperature. It starts melting at a little above room temperature and is completely liquid at about 300 F.

This organic has a number of advantages as a reactor heat transfer working fluid compared to other coolants such as water: (1) low vapor pressures; (2) very low corrosion rates; (3) no possibility of violent exothermic chemical reaction with the fuel materials; (4) very low induced radioactivity; (5) good neutron moderator with easily obtainable, safe, power coefficient; and (6) higher steam temperatures and steam cycle efficiencies than those attainable from water cooled reactors. The low vapor pressure, approximately 13 psia at 700 F, allows the use of low pressure piping, valves, vessels, etc.

The very low corrosion rates and general compatibility with normal materials of construction enables the use of ordinary low carbon steel pipe, valves, tanks, etc. Avoiding the expensive materials helps simplify the supply of pipe, valves, etc., as well as saving money in machining, welding and erection.

The organic coolant is kept very clean, as is necessary for all types of reactor coolants. Essentially this leaves only the compounds of hydrogen and carbon circulating through the reactor, the piping systems and steam generators. Neither of these chemical elements become radioactive when they pass through the fuel assemblies. The fact that the radioactivity of this coolant is so low, being due to trace impurities, makes it possible to inspect equipment, tighten valve packings, lubricate equipment, replace malfunctioning instruments and do other short contact maintenance jobs while the plant is running. Also, leaks are much less serious.

The power coefficient of a nuclear reactor is a measure of the tendency for power to continue to increase, without any additional action of the control equipment, after a positive increment of power has been achieved. For a reactor to be safe, it is highly desirable for this coefficient to be negative. This can be attained easily and adjusted to an optimum value by adjusting the ratio of uranium to hydrocarbon coolant in the region of the fuel assemblies called the core.

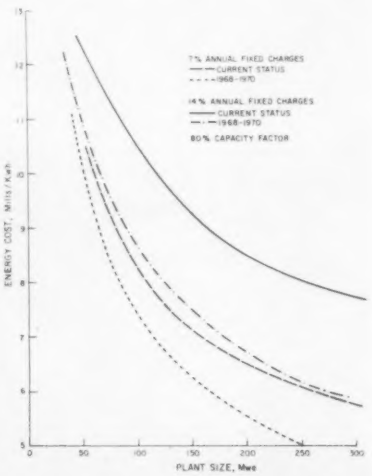
The net thermal efficiency of this system is 32% for a 50-mw plant.

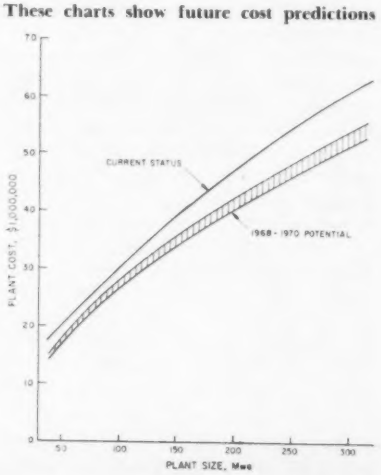
The AEC is having the components of an advanced type developed at the Santa Susana, Calif., field laboratories of Atomics International. This will have components applicable to much larger plants as well as being useful for the 50- to 100-mwe sizes.

This reactor type is considered one of the safest. It is maintained that containment shell buildings are not necessary. However, the Piqua, Ohio, station is located very close to the population center so it was built conservatively in a cylindrical containment building. This is a low pressure shell being designed for 5-psi pressure. It would be cheaper to omit the containment and build with vapor suppression or just conventional mill-type construction. Either of these would be adequate on a site that is not immediately adjacent to a considerable population center.

Plant costs and power costs are shown by the curves. It is estimated that a 300-mwe plant to go into operation in the period 1968-70 will cost $51 to $54 million and produce power for 5.6 to 5.9 mills/kwh when owned and operated by a private utility.

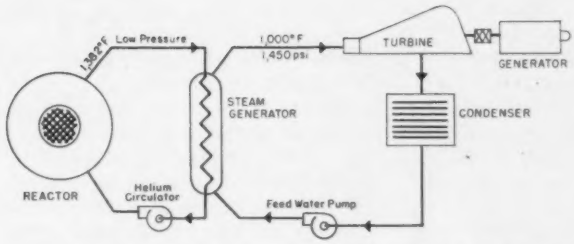
These charts show future cost predictions





GAS COOLED REACTORS

PETER FORTESCUE, T. G. LECLAIR, C. L. RICKARD, GENERAL ATOMIC DIVISION OF GENERAL DYNAMIC



Fuel: Uranium
Coolant: Helium
Moderator: Graphite
Key advantage: Can use natural uranium

Flow diagram of typical contemporary design of high temperature gas cooled reactor

To Cover properly the various features of the advanced high temperature gas-cooled reactor plants, it seems important to give first a little background on the earlier gas-cooled reactors.

Shown is a graph giving the distribution, by types and by total electric capacity, of power reactors that are presently in operation, under construction or contracted for. It can be seen that gas cooling, as represented by graphite reactors, clearly dominates the record. In large measure, of course, this is due to the extensive gas-cooling programs of the British and French, but gas-cooled stations are also planned or under construction in Italy, Japan, Germany and the United States.

The first gas-cooled power reactor was the British Calder Hall reactor, commissioned in 1956. This reactor is cooled with CO_2 gas, is graphite-moderated, and is fueled with natural uranium.

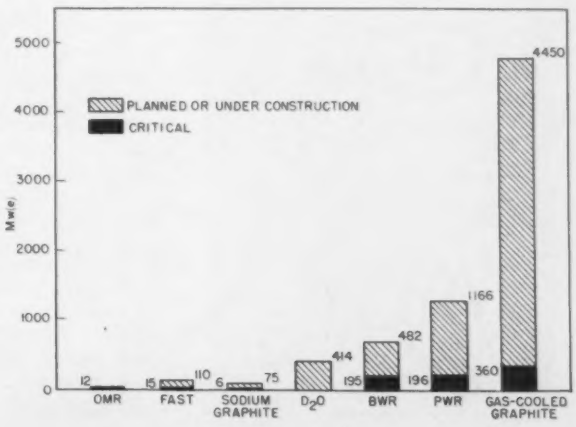
A natural outgrowth of this type of reactor is one using enriched uranium fuel, thus freeing the designer from the limitations imposed by natural uranium. This stage in gas-cooled reactor development is typified by the British Advanced Gas-Cooled Reactor and the U. S. Experimental Gas-Cooled Reactor at Oak Ridge, both of which are designed for enriched fuel. The operating temperatures (gas outlet temperature of 1,000 to 1,100 F) and power densities (1.5 to 3 kw/liter) represent a substantial improvement over those obtainable with the earlier natural uranium reactors. Ultimately, reductions in capital cost and a substantial increase in fuel performance are also expected.

At the present time, development of the HTGR system for central power station application is proceeding rapidly. The 40,000-kw HTGR prototype development program was initiated with the objective of completing construction of the plant by the end of 1963. This plant will be owned and operated by the Philadelphia Electric Co. and will be located on the company's system at Peach Bottom, Pa. Development of the plant is being supported by the High Temperature Reactor Development Associates, a group consisting of 53 investor-owned utility companies. Research and development for the nuclear portion of the plant is being carried out by General Atomic under contract with the U. S. Atomic Energy Commission. Bechtel Corp. is prime contractor to Philadelphia Electric for construction of the plant. General Atomic will also furnish the fuel and the nuclear steam-supply equipment for the plant.

The 40,000-kw prototype HTGR plant is being designed to demonstrate in a commercial-sized plant those features that in large systems are believed to be necessary for the attainment of economic power through effective use of modern steam conditions. It is being designed to produce steam at 1,450 psi and 1,000 F. These steam conditions are somewhat higher than are warranted by the size of the plant; however, they are used for the prototype plant to demonstrate the operating features intended for larger plants to be built in the future.

The high-temperature, high-fuel-burnup, gas-cooled reactors appear to hold great promise for the future. The HTGR system, the most advanced of these systems at the present time, has the ability to use high steam pressures and temperatures and to attain an over-all efficiency of 40%. These features, coupled with high power density and the use of conventional materials of construction, lead to the possibility of reduced capital costs for large units. The expected fuel cost is exceptionally low because of the high fuel burnup and good neutron economy. The fuel costs for 300 mw and larger sizes are expected to be in the range of 1.5 mills per kwh or less, an important factor in utility system efficiency. The expected low fuel cost, high plant efficiency, and reasonable capital cost give the prospect of an over-all power cost in the near future which will compete with power from coal in many areas of the United States.

In the 300- to 500-mw range, General Atomic is working on a three-year development program for the Empire State Atomic Development Associates based on the HTGR concept, directed toward ultimate construction of a large nuclear plant in New York State.



Bar chart shows distribution by types and total electric capacity of power reactors that are presently in operation, under construction or contracted for. Programs of British and French account for a large amount of the gas-cooled graphite reactors

PRESSURE SUPPRESSION

Developed jointly by PG and E and General Electric, this method of containment offers substantial savings at Humboldt and Bodega Bay

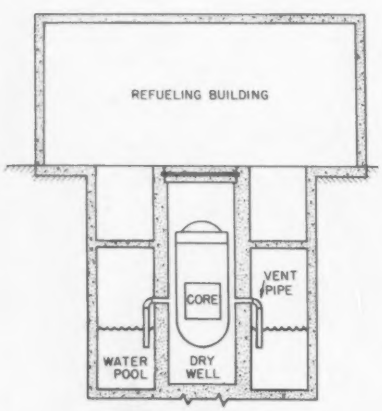
CHARLES H. ROBBINS, GENERAL ELECTRIC CO. AND DAVID B. BARTON, PACIFIC GAS AND ELECTRIC CO.

OPERATION of pressure suppression will very probably never be required, yet the large supporting development program is considered highly successful and the new design deemed an advance. This apparent paradox is possible because pressure is a new type of reactor safety containment.

Reactor containment is provided as a back-up to other safety devices in a nuclear power plant to prevent dispersal of fission products, in the unlikely event of a nuclear incident. Large dry pressure vessels in the form of spheres or cylinders have been previously used for containment. Pressure suppression, as suggested by General Electric's atomic power equipment department, uses a water pool inside a container to condense steam that might escape should a rupture occur in the reactor system.

Design considerations: The savings from pressure suppression and new techniques in fuel fabrication

Pacific Gas and Electric became interested in pressure suppression because of its potential safety and cost advantages and decided to finance its development. The development program conducted by G-E and PG and E was started several years prior to its culmination in the fall of 1960 when a construction permit was issued by the AEC for PG and E's Humboldt Bay plant nuclear unit with pressure suppression containment. The program has cost PG and E more than $400,000, but conventional dry containment for Humboldt would have cost $650,000 more than pressure suppression.



SIMPLIFIED ARRANGEMENT OF CONTAINMENT

Pressure Suppression Concept

The basic ideas of pressure suppression are shown in figure. The reactor vessel is contained in a gastight dry well normally filled with air at atmospheric pressure. Vents lead from the dry well into a pool of water, which is also in a gastight enclosure. In the very unlikely event of a break in the reactor primary system, water and steam would escape causing a rise in the dry well pressure. Air, steam and water from the dry well would then flow through the vents to the water pool where the steam would be condensed. Because of the absorption of released energy in the water pool, the post-accident enclosure pressure would be relatively low.

Advantages

Pressure suppression has several important potential safety advantages over the more conventional dry containment using large pressure vessels in the shape of spheres or cylinders. Pressure suppression, by quickly absorbing the released energy, would permit a relatively small rise in containment pressure in the event of an accident. A lower pressure rise in the enclosure would reduce the rate of possible leakage. In addition, in the event of an accident, any fission products escaping from the reactor vessel would largely remain in the small physical volume of the dry well. The small volume of the containment makes it practical to place the reactor and its containment below ground; the ground can provide radiation shielding and some added support for the containment structure. The escape of fission products from the dry well is further impeded by the tendency for fission products entering the water pool to be retained therein.

Potential cost savings are possible with pressure suppression largely because energy absorption permits compactness and helps simplify plant design.

When this idea was first considered, it appeared extremely attractive. Firm designs, however, had to be based on answers to many questions. The development program provided the solutions required.

Development Program

The development program was conducted in four different phases.

The first phase was one of determining basic feasibility. Condensation of steam was explored in small scale tests, transient pressures and dynamic forces were considered by analysis, and the work of the next two phases was planned. The results of the first phase were highly encouraging and justified proceeding with the rest of the program.

Two new facilities were designed, built and operated during phase two. One was the condensing test facility at Moss Landing power plant of PG and E. The second test facility, located at the San Jose plant of G-E, was a small model of pressure suppression system and investigated transient conditions during simulated operation. Information obtained during phase two was intended to be broad in nature to anticipate the ensuing containment designs.

The third phase of development consisted of analyzing the information acquired and interpreting it in terms of plant design. Phase three was aimed at determining the design bases and requirements for pressure

suppression containment for reactor plants in general.

At the completion of the third phase, the results obtained were utilized by Bechtel in the design of the reactor containment for the Humboldt Bay plant nuclear unit.

After the design was completed, PG and E decided to build and test a portion of the Humboldt Bay pressure suppression containment at full scale. This appeared necessary to prove conclusively the adequacy of the containment concept and the actual design. This demonstration was phase four and the final step in the development of pressure suppression. After the successful completion of this phase, the AEC granted PG and E a construction permit to build a nuclear unit at Humboldt Bay incorporating this new method of containment.

Containment Demonstration

To demonstrate the operation of the Humboldt Bay pressure suppression design, a special test facility was built at Moss Landing power plant. The Humboldt containment design uses 48 14-in.-diameter vent pipes arranged around the outside of an annular-shaped pool. The test facility reproduced to full size and shape one of the 48 vent pipes, the portion of the suppression chamber and pool associated with it, and an appropriately sized dry well and reactor vessel. On this basis, the pressure vessel simulating the reactor vessel was made from 20-in. pipe with a volume of 55 cu ft.

Transient tests were conducted with the water and steam in the reactor vessel initially at 1,250 psig. To initiate the transient, a rupture disk was broken allowing water and steam from the pressure vessel to flow through a vent pipe which simulated the length and resistance of the Humboldt vents. Transient pressures were measured and recorded continuously at various locations and temperatures were also measured at strategic locations. Many parameters were varied in the 45 tests conducted including orifice size, dry well internals, addition of air to the dry well, depth of submergence, and water pool temperature.

The results of the tests show conclusively that the Humboldt containment system could handle the maximum credible operating accident (MCOA) with a large margin of safety. The conclusion arrived at from the previous reduced scale tests were all verified by the full scale tests. The maximum dry well pressure for tests representing the Humboldt MCOA was in the range 25-36 psig as compared with the design pressure for the Humboldt dry well of 72 psig. The difference between test and design is largely a result of the very conservative assumption used to calculate the rate of reactor vessel blowdown.

Condensation in the water was rapid and complete for a wide range of parameters including and exceeding the design conditions for the Humboldt containment system. The maximum energy release rate tested was about 145,000 kw and resulted when the water in the pressure vessel was emptied in six seconds through a 3.28-in.-diameter orifice. This energy was completely absorbed in the pool containing less than 400 cu ft of water.

The development program demonstrated by (1) analysis, (2) reduced scale, and (3) full scale experiments that pressure suppression is a workable form of reactor containment which can offer increased safety at a reduced cost.

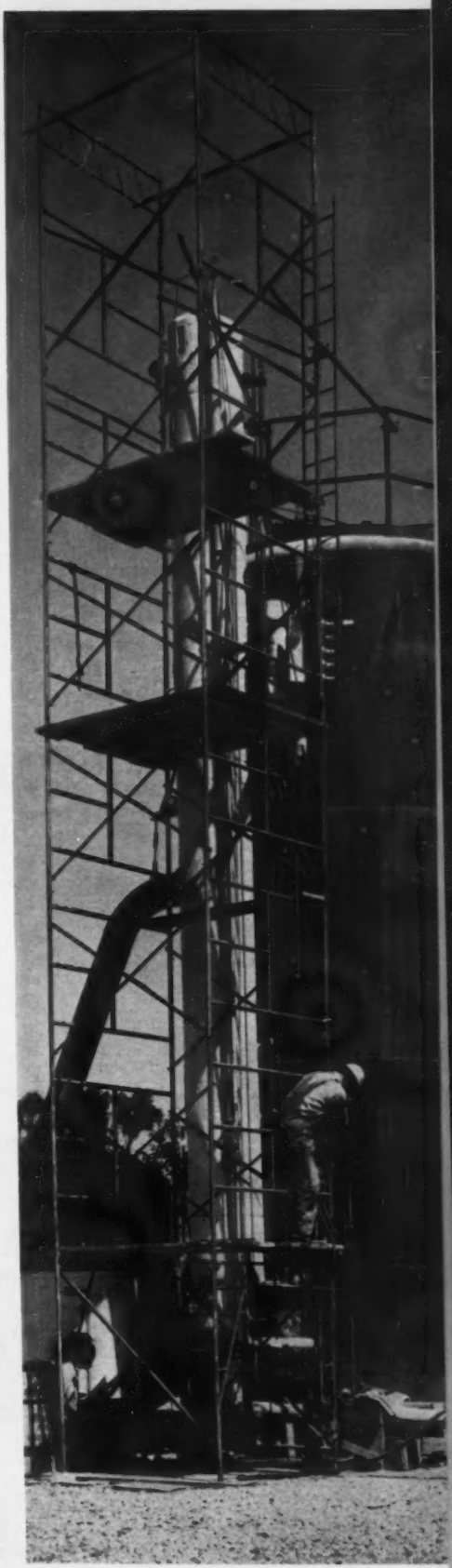
The magnitude of the pressure development program helps demonstrate the importance given to reactor safety by both utilities and reactor suppliers.

The effort to learn how pressure suppression could and should be designed was extensive but has been well justified. The development program has provided a firm basis for one of the recent major advances in power reactor technology.

Additional Use at Bodega Bay

Since the writing of this article, the Pacific Gas and Electric Co. announced its intention to build a 325,000-kw nuclear power plant at Bodega Bay, about 50 miles from San Francisco on the Pacific Coast. This plant will use a formed circulation boiling water reactor supplied by the General Electric Co.

Like the Humboldt Bay nuclear unit, this plant will use a pressure suppression system of reactor containment. The reactor and containment system will be enclosed in a concrete and steel structure built below ground to a depth of about 100 ft. Experience gained from the Humboldt Bay pressure suppression test program described in this article will prove valuable in the design of the Bodega Bay containment.



Special test facility was built at Moss Landing power plant to demonstrate the Humboldt Bay pressure suppression design

THE COST OF NUCLEAR FUEL

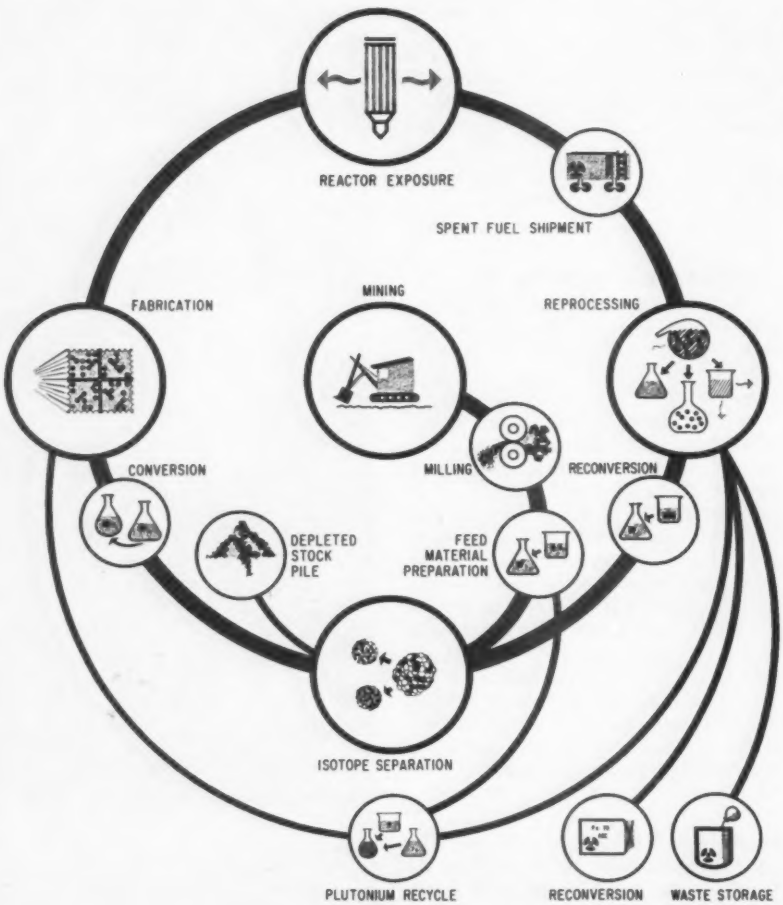
Looking at costs today and tomorrow it seems reasonable and conservative to expect them to be halved in the next decade

R. H. GRAHAM, ATOMIC POWER EQUIPMENT DEPARTMENT, GENERAL ELECTRIC CO.

THE MATURING nuclear program in this country has begun to dictate stabilized channels of fuel supply. Five years ago, there were multiple reactor cycles competing for selection, as well as an overwhelming array of fuel designs. It is now apparent that many power reactors of the '60s and early '70s will be single or dual cycle water systems. Predominate fuels will be slightly enriched (2 or 3% U-235) uranium dioxide which has been clad in stainless steel or zircaloy jackets.

To understand the economics of this new fuel, the path of uranium must be traced from its origins in ore bodies, through the processing steps and its end use in energy production. The eventual distribution between recycling of unused fuel material and perpetual waste storage must also be considered. This flow is shown in the accompanying chart.

The physical and chemical forms the uranium takes in its movement through this chain are shown in the table on the opposite page.

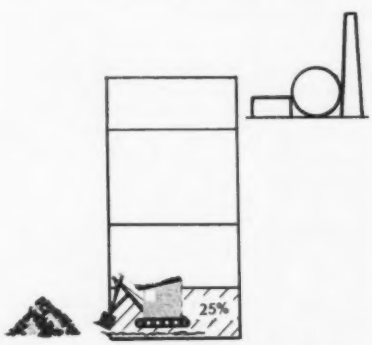


In this analysis the "shop costs" begin with ore reserves as the input and end with uranium and plutonium prepared for recycle or further use. They are the actual values contributed to the fuel as opposed to initial or final monetary worth. These fuel cycle costs do not include credit for the value of residual uranium and plutonium, but do include the chemical and physical processing (including mining and milling) required for extraction of energy from uranium.

To analyze the costs associated with the fuel cycle from beginning to end, the processing costs can be grouped as shown in the table.

Raw Materials Processing

The cost analysis shows that 25% of the fuel cycle cost is required to mine and mill ore and to transform crude ore concentrates to finished hexafluoride ready for the diffusion plant where isotopic enrichment takes place. Ore is usually concentrated by acid leaching and solvent extraction.

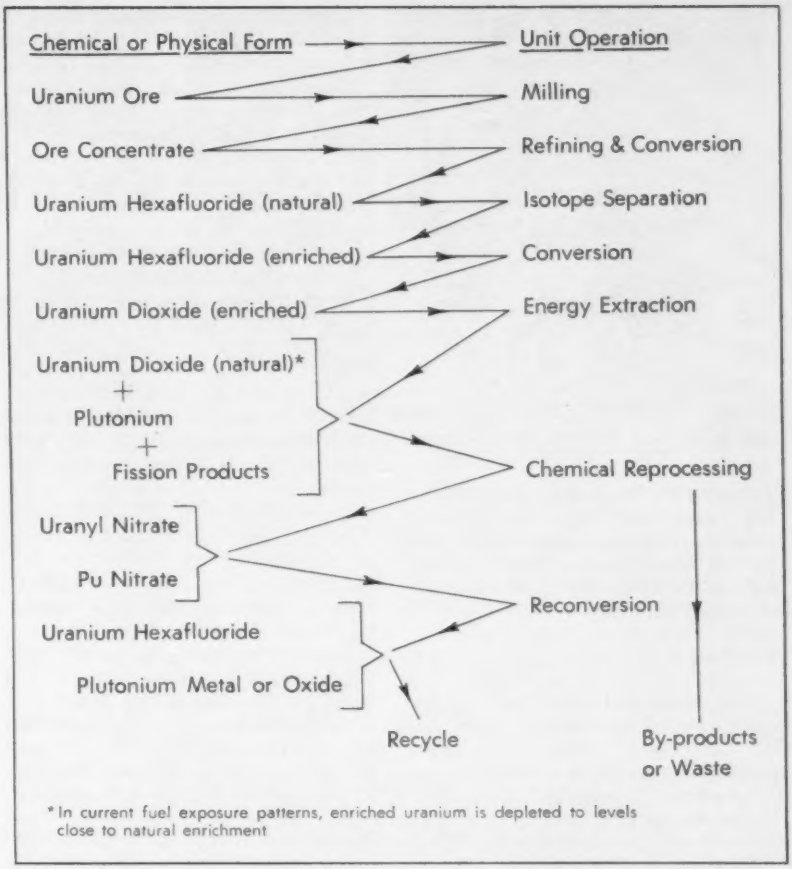


The established U. S. method for concentrate processing is dissolution of the crude ore concentrates in nitric acid, purification by solvent extraction and calcination to uranium trioxide. The trioxide is reduced to the dioxide and converted to the tetrafluoride by countercurrent flow of hydrogen fluoride. Tetrafluoride can be diverted at this point to production of natural metal by reduction with magnesium. The tetra-

fluoride from which the enriched fuel will be produced is reacted with fluorine to produce the hexafluoride.

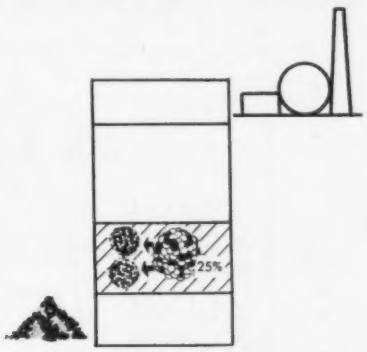
A newer process employs fluidized beds for reduction, followed by hydrofluorination and fluorination with a final distillation for purification.

The high fuel costs created by these straightforward chemical processes are due to the crash development in the 1940s of a flexible and invulnerable supply of weapons source material. Adaption of mills to private markets by production of pure tetrafluoride rather than crude oxide concentrates can reduce processing costs with very minor modifications of mill flow sheets.



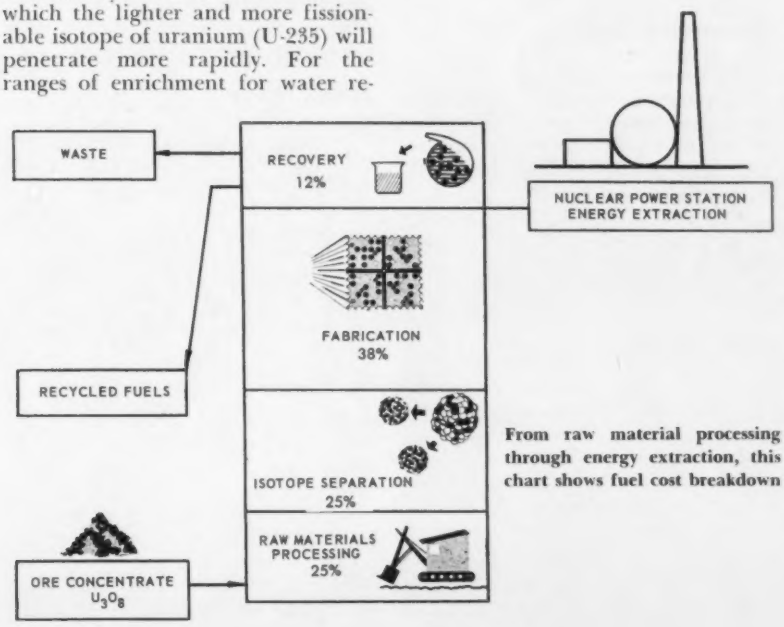
Isotope Separation

The slightly enriched reactors permit use of light water as moderator



and coolant. The massive gaseous diffusion plant complex of the AEC is basically a cascade of barriers which the lighter and more fissionable isotope of uranium (U-235) will penetrate more rapidly. For the ranges of enrichment for water reactors (2 to 3% U-235), an upgrading of natural (0.7% U-235) material by a factor of about four is required. Because of the extremely large investment, the diffusion plants represent tremendous inertia and therefore fixed processing costs that are not expected to change.

Development of gas centrifuges is proceeding in this country and in Europe. These are not expected to reach a level of competition with the diffusion plant within the coming decade. Their development is desirable because of the flexibility of these smaller machines to accomplish other isotopic separations such as removal of the undesirable Pu 240 from the other plutonium as well as the promise of low capital costs for a facility which would provide modest degrees of enrichment.

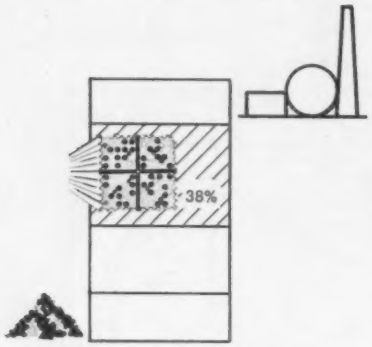


From raw material processing through energy extraction, this chart shows fuel cost breakdown

Fabrication

This phase begins with the now enriched uranium hexafluoride product of the diffusion plant that is first converted to a ceramic-type uranium dioxide that has proved it can successfully survive long exposures in the reactor core. Currently the oxide powder is sintered into cylindrical pellets, which are inserted into zirconium or stainless steel tubes. The tube ends are closed with end plugs and the tubes assembled with end boxes.

Future simpler manufacturing, such as vibratory compaction of loose powders within the tubing jacket, will reduce fabrication costs. The



completely automated manufacturing process that will come with high volume, low cost production will permit inclusion of recycled toxic or radioactive fissionable material without large penalties.

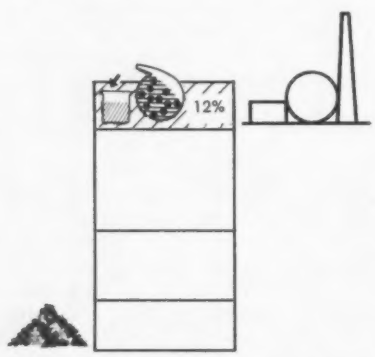
Recovery

The recovery of unused fissionable material represents 12% of current fuel cycle costs. This can be further separated as follows:

Spent fuel shipping	2%
Reprocessing	7%
Uranium conversion	1%
Plutonium nitrate to plutonium conversion	2%

The spent fuel assemblies are held at the reactor site for cooling for several months or longer as batches of elements are accumulated. The assemblies are shipped in a specially shielded railway car with provision for continued dissipation of the residual heat.

Reprocessing begins with dissolution of the fuel element in concentrated acids followed by solvent extraction. This technology has been



so completely developed for weapons production that practically complete recovery is realized with decontamination factors sufficient to produce completely clean materials. The AEC created a reprocessing price by designing a hypothetical plant in 1957. These costs, escalated to today's values, are still sufficiently low and the volume of fuel to be reprocessed is sufficiently uncertain to discourage private firms from entering the field, despite strong government encouragement to do so.

The solvent extraction process is efficient and well understood, so that its obsolescence will be slow. A study has been made of a plant small enough to reprocess discharge economically from a single reactor which show high costs. Reprocessing by melting and slag refining of metal fuels is an automated refueling plant associated with a single reactor represents perhaps an ultimate, as extrapolated from today's technology. The large single plant will, however, do all reprocessing within the decade, with perhaps one private plant supplanting the AEC's Savannah River operation in about five years.

The commission will accept for credit at stated prices those fissionable materials remaining in the fuel after discharge. Aqueous reprocessing separate solutions of uranium and plutonium as nitrates. Current fuel cost estimates include conversion of the uranium from nitrate to hexafluoride for recycle through the diffusion plant. Plutonium nitrate is reduced to metal. Future developments of fuel cycles may include blending of discharged uranium or plutonium with unenriched fuel. Different conversion unit operations will not markedly alter fuel cycle costs.

Government Control

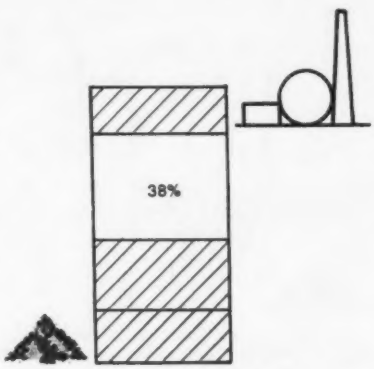
As shown in the bar chart, the government now controls all but the 38% spent for fabrication. The costs of raw materials processing and isotopic separations are included in the price of enriched uranium.

The cost of recovery (excluding spent fuel shipping) is derived from the hypothetical AEC reprocessing plant, subject to change by the government.

The Atomic Energy Act of 1954 directs that the nuclear power industry be turned over to private operation as rapidly as possible. The AEC has been requested to sell the services of its isotope separation facility. If this is permitted, the fuel manufacturer can buy from a free market in ore concentrates, and purchase diffusion plant service only from the government. This frees the first 25% of the "shop cost" from government control. The raw materials industry now—having the AEC as its sole customer—is, in fact, a regulated industry.

If AEC increases costs of services beyond normal escalation, the area of competition of nuclear power will shrink. If AEC declines to guarantee plutonium credits on which investment return depends, exploitation of nuclear power will continue to be delayed.

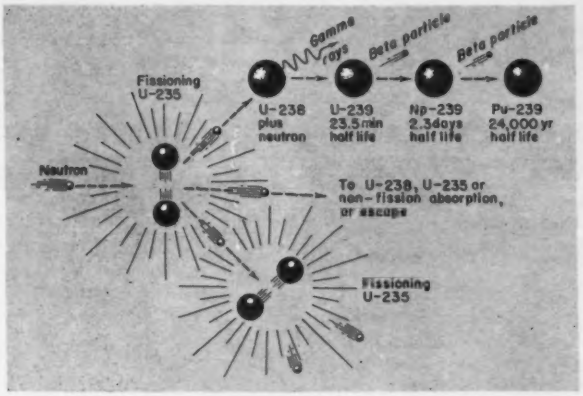
If AEC can assist private industry in justifying the large investment required in a reprocessing plant—by stability of plutonium credits and providing a base load of government fuels—industry will move into the recovery sector promptly. The centrifuge, which may attain a capability of economically separating low enrichment fuel in the early '70s, can complete private industry's obligation to encompass this technology. It is tacitly assumed that control—initially via le-

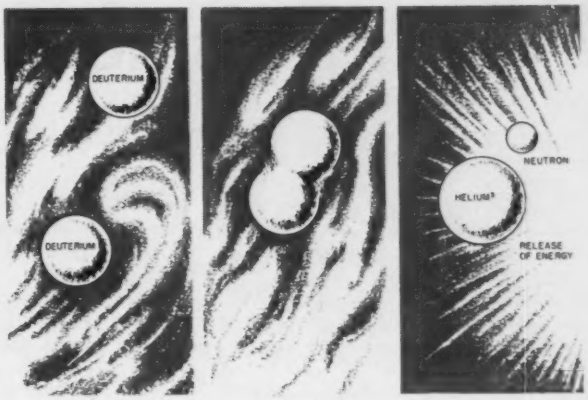


gal ownership—of materials important to security will continue to be exercised by the government.

Future Trends

Without much technical improvement, it will be possible to reduce raw material processing costs by a factor of two by accepting some risk of supply continuity, which is unacceptable in a military procurement program. This cost decrease, added to capital cost improvements achieved through advanced plant designs, can expand the market. Increased volume will justify manufacturing improvements capable of reducing current fabrication levels also, by a factor of two by the mid-1960s. Reduction of recovery (optimistically priced now) and of separation components will be delayed until the 1970s. For planning purposes, it seems reasonable and conservative to expect 1960 fuel cycle cost to be cut in half in 10 years.





Fission diagram (left) shows neutron causing fission of U-235 leading to chain reaction creating energy and plutonium. At right, the diagram depicts the fusion of two deuterium atoms forming helium-3 and energy. Diagram, courtesy General Atomics

FISSION OR FUSION

FISSION—the breaking apart of atoms—is well understood and these pages are filled with descriptions of the many different approaches being investigated to utilize the power released when a small portion of the mass of the heavy atom (uranium-233, U-235, or plutonium) is converted into energy when the atom fissions.

Fusion—the welding together of two light atoms like deuterium—as a physical process is just as well understood. However, practical methods of making this reaction a controlled phenomena are the subject of much investigation at the present time. General Atomic, General Electric, Atomics International and the University of California, both at Los Alamos and Livermore, are looking for ways to bring to fruition the use of the energy created when two atoms fuse. It is well to note that the immediate program of these research centers is being directed toward fundamental methods involved rather than toward an early use of fusion energy.

Why fusion anyway? First is its promise of an unlimited fuel supply. For, once a fusion plant is made practical, the oceans become our fuel yard. This fuel, deuterium (or heavy hydrogen), is estimated to be plentiful enough in the sea to sustain an energy production rate a thousand times the world's present capacity for a billion years.

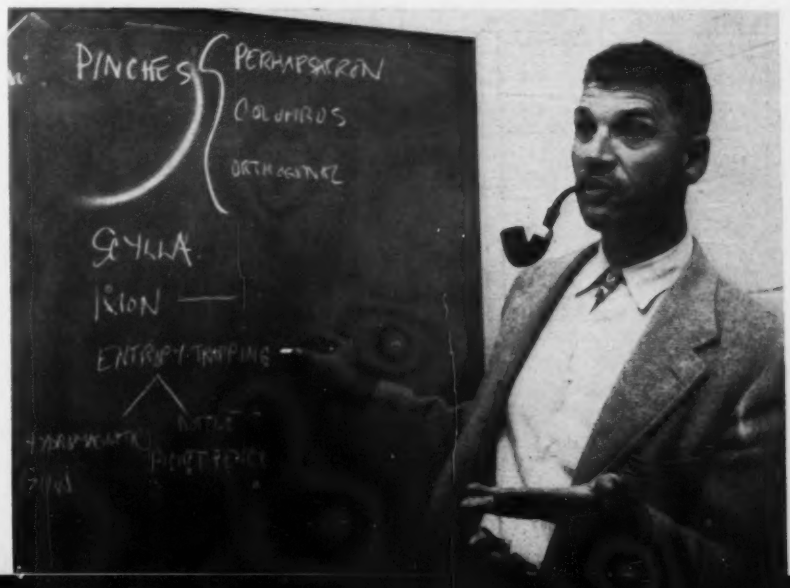
The second reason to push for a fusion plant is that the reaction is clean compared to fission plants.

Controlled thermonuclear reactions (fusion) have been achieved on a laboratory scale but only at a large net cost in energy. To produce such a reaction without having to put in more energy than comes out, it is necessary to devise a suitable means of confining and heating an ionized gas—probably deuterium. The problem is difficult because of the high temperatures required for fusion. Temperatures in millions of degrees centigrade will be required. At temperatures high enough for practical operation of a thermonuclear reactor, no substance could exist in solid form. This means that the confinement of deuterium plasma (ionized gas) must be by nonmaterial walls such as those produced in effect by magnetic or electric fields.

Now, the plasma can be contained but brings along with it the problem of providing the tremendous quantities of energy required to produce a suitable magnetic field. This led to the study of superconductors—the phenomena exhibited by most conductors whereby their resistance is reduced drastically when subjected to extremely low temperatures.

Messrs. Kunzler, Buehler, Hsu and Wernick published, in Physical Review Letters of Feb. 1, 1961, a report that a four-mil wire of niobium tin has been kept superconductoring while carrying a current of 30 amp in an externally supplied magnetic field of 88 kilogauss. The ability to maintain large magnetic fields at the mere cost of maintaining the system at four degrees Kelvin against the usual heat leak of, say, 10^{-4} w per sq cm, completely alters the economics of theoretical thermonuclear reactors.

Los Alamos scientists report that very real progress in plasma physics is being made and this, together with some exciting new ideas not even tried yet, leads one to believe that in the next five years there is a 50-50 chance—not of making a thermonuclear reactor—but of finding out how.



James L. Tuck of Los Alamos describes theories developed for fusion experiments

LICENSING OF OPERATORS

H. L. PRICE, ACTING DIRECTOR OF REGULATION, U. S. ATOMIC ENERGY COMMISSION

THE ATOMIC ENERGY ACT directs the AEC to prescribe uniform conditions for licensing individuals as operators of any licensed reactor. The commission's regulations provide that a reactor licensee shall not permit the manipulation of the controls of a reactor by a person who is not a licensed operator. An operator is an individual who actually manipulates the controls, or who directs another to manipulate the controls in his presence.

No minimum education or experience requirements have been established for an operator's license. The

Operations: How to train and license operators. A look at nuclear waste. Radiation safeguards

commission gives an examination to determine that the applicant can operate the reactor for which he seeks a license in a safe and competent manner. An individual who seeks a reactor operator license submits an application, which must include the following: (1) evidence that he has learned to operate; (2) consent of the owner to use for testing purposes the facility for which a license is sought; (3) a certificate of medical examination.

After the application is reviewed, an AEC representative is assigned to give the examination.

This consists of two parts: an operating test and a written examination. Normally both parts are given at one time, although this procedure is not mandatory. The examination is prepared from data and information contained in the hazards report and operating manuals of the reactor. It is intended to test the following:

1. The applicant's understanding of, and familiarity with, the reactor's general design and operating characteristics, control and safety systems, all control-station instrumentation, standard operating procedures, emergency shutdown system and procedures and such other aspects as may be important to the safe operation of the facility.

2. The applicant's ability to read and interpret the control instrumentation of the reactor and to manipulate the control equipment in a safe manner and the knowledge of how to operate the reactor, including operation under emergency conditions.

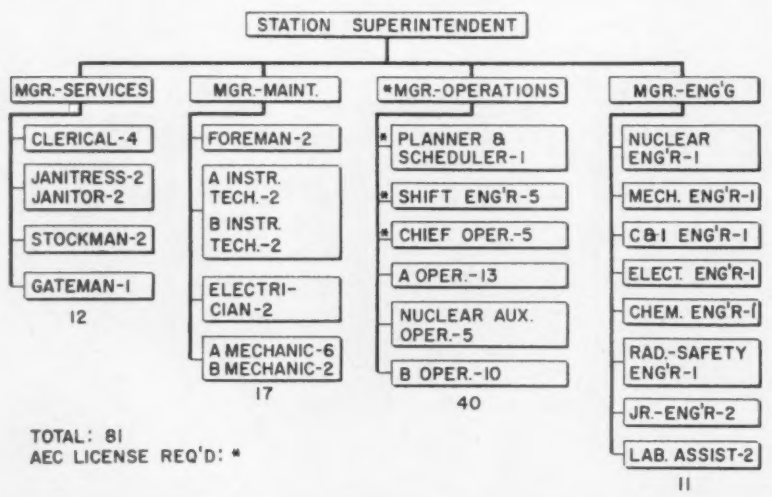
3. The applicant's knowledge of procedures, rules and regulations on radiation protection of personnel, including the purpose and function of the radiation monitoring equipment.

Generally speaking, the written examination tests the applicant's knowledge of specific details of the facility and procedures; the operating test requires a demonstration of his ability to perform the steps necessary to operate the reactor properly. The latter test includes performance of operations listed on the instrument and control check list; actual operation of the reactor; recognition of, and actions required by, warning signals; proper interpretation of control readings; operation of necessary auxiliary systems; proper use of the radiation monitoring systems; and ability to carry out the normal and emergency procedures.

When examining applicants for license to operate power reactors, we usually limit the scope of the examination to those portions of the over-all facility whose operation (or misoperation) could have an effect on the reactor, or result in the release of radioactive material.

Inasmuch as a reactor is considered to be in operation at the time of initial loading of fuel, it is apparent that a facility must have some licensed operators before the reactor "goes critical," that is, before the first sustained chain reaction takes place. For this purpose the commission will administer a "cold" test on the facility.

Presently the commission issues a single license to reactor personnel—that of reactor operator. For some time the need for additional classes of licenses has been recognized. In particular, the commission is considering the desirability of issuing separate licenses to supervisory operators. The supervisor's examination would cover such items as specifics of the facility license and technical specifications, procedures required for design and operating modifications, reactivity effects, core loading procedures, fuel and control rod programming, fuel handling, shielding requirements, waste disposal and a reasonable knowledge of reactor principles. Before it initiates such a change, the commission would follow its customary practice of inviting public comment on a published form of the proposed addition to its regulations.

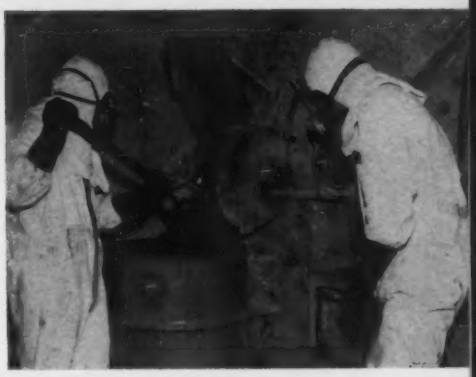


Proposed manning table for a 300-mw nuclear plant.—Courtesy, General Electric Co.

NUCLEAR WASTE

The disposal of nuclear waste need be no major obstacle to nuclear plant operators

J. S. CORBETT, CHIEF RADIATION OFFICER, NUCLEAR ENGINEERING CO. INC.



All liquid radioactive waste must be solidified and placed in proper containers

NUCLEAR POWER STATIONS, like other industrial users of radioactive materials, are faced with problems that are new and different compared to those encountered in the operation of conventional power stations.

During operation and maintenance of a nuclear power station, personnel who perform the routine function must be provided with equipment to protect them from radiation hazards; instrumentation is required to measure radiation levels; a variety of dosimeters is needed to measure radiation exposure received by the operating personnel and protective clothing and equipment must be provided to prevent the spread of radioactive contamination to personnel, equipment and the surrounding areas.

The routine operation of a nuclear power station also carries with it another problem that is peculiar to the nuclear industry—the disposal of radioactive wastes. These include mixed fission products from the nuclear chain reaction and radioactive corrosion products from reactor components and coolant. Waste materials generated during operation cannot be handled and disposed of in the normal fashion but must be packaged and disposed of in accordance with rules and regulations prescribed by the AEC.

There are companies in the United States such as Nuclear Engineering Co. Inc. of Pleasanton, Calif., who provide a wide variety of services and supplies for nuclear plant operators. These include radiological protective clothing supply and decontamination, radioactive waste disposal, decontamination and repair of equipment, radiation protection consultation and a wide variety of protective equipment.

Radiological protective clothing services provided by such contractors include the pickup, decontamination and delivery of many items such as coveralls, head coverings, shoe coverings, gloves and plastic suits of many different designs, including suits with wholly independent air supplies. When using these services, the power station operator is relieved of the problems involved in maintaining supplies and particularly those problems associated with the decontamination of the protective clothing. The contractor picks up protective clothing at customer facilities in his own trucks and launders and processes them to insure that they are safe for return. All items are pre-monitored to determine if there is any high level contamination present. If so, these items may be discarded as radioactive waste or portions of the item may be cut away and repaired. Clothing items are decontaminated in stainless steel washers using detergents that have been specifically compounded to remove radioactive contamination. The decontamination process is very similar to that of a normal commercial laundry with the exception that higher water temperatures are required. All protective clothing items are carefully monitored for residual contamination following decontamination.

The extreme caution necessary in handling and processing protective clothing does increase the costs. Per use or unit costs of the clothing run from 50 to 100% higher than the costs for normal industrial garment services.

Nuclear waste contractors also provide complete radioactive waste disposal services. These services are usually tailored to each customer's requirements with the specific purpose of eliminating as many of the customer's problems as possible. Disposal services include providing various standard and specially designed containers properly labeled to meet all applicable federal regulations; pickup at customer facilities under the direction of technicians who are highly trained for such work; the escorted transportation to interim storage facilities; processing into concrete for sea disposal and the final movement to an AEC designated sea disposal site. If sea disposal is not utilized, the packaged waste material is transported to AEC land burial sites at the National Reactor Testing Station near Idaho Falls, Idaho, or to Oak Ridge, Tenn.

Liquid radioactive wastes are picked up at customer facilities either in ICC approved double wall containers for small volumes or in a Bureau of Explosives approved cargo tank for volumes of 1,000 gal or more. All liquid radioactive wastes must be solidified prior to disposal at sea or burial at AEC land burial sites.

Costs for radioactive waste disposal services vary according to the kinds and quantities of radioisotopes involved. Standard rates for small volumes of low hazard wastes are $6.10 per cu ft for solids and $1 per gallon for liquids.

Nuclear waste contractors also provide for the decontamination and repair of equipment such as motors, pumps, tools, and so forth, used in nuclear facilities. When failures occur, the repair of such equipment is complicated because of the radioactive contamination and costs are considerably greater than for nonnuclear applications. Still, repair is economical when the initial high cost of such equipment is considered.

Later these containers are dumped at sea or buried at designated AEC land sites

Main facilities of the plutonium recycle program. The dome-shaped structure is reactor, square building is fabrication pilot plant

PLUTONIUM RECYCLE ADVANCES

The program to develop technologies to use plutonium as a power reactor fuel moves forward as Hanford's test reactor reaches design power level

R. M. FRYAR, HANFORD OPERATION, GENERAL ELECTRIC CO.

THE ELEMENT PLUTONIUM does not exist in nature. It is an unavoidable by-product of the fission of uranium. As an element it possesses nuclear characteristics similar to uranium in that it can fission and be used as a fuel. At present, the government offers nuclear plant operators a payment for the plutonium by-product. Plutonium credit is based on estimated value of the energy obtainable from plutonium fueled reactors. To date, knowledge about plutonium fuel is miniscule.

The future: Will plutonium recycle extend fuel supplies? What does direct conversion offer? How do industry leaders view it?

The objective of the plutonium recycle program is to obtain basic knowledge for use in developing a system whereby plutonium produced in one fuel cycle of a power reactor would be used to enrich fuel in a later cycle – that is, it would be recycled.

Hanford's Plutonium Recycle Test Reactor reached its design power level of 70 mw(t) on July 21, 1961, as the startup testing program continues. PRTR is heavy water cooled and moderated and is the principal facility of the AEC's plutonium recycle program, which is being conducted by the Hanford Laboratories of General Electric Co. The reactor is currently fueled with 55 uranium oxide elements and 30 plutonium aluminum alloy elements. It is the first reactor type to operate under power reactor conditions with plutonium as a substantial portion of its fuel.

The performance of the PRTR to date has either met or exceeded nuclear design expectations and has shown that the reactor is easily controlled and has excellent nuclear safety characteristics. Varying the moderator (heavy water) level as a method of reactor power control has demonstrated that this system is very smooth and highly desirable. The rate of reactivity addition is in essential agreement with predicted rates.

Accomplishment of emergency shutdown by dumping the moderator from the reactor core is more rapid than originally anticipated. Moderator dump rate tests using one, two, three and four dump valves show that, when any one or more dump valves open, the moderator level will fall 2 ft in less than 1.05 seconds, rendering the reactor subcritical. Added safety factor is that over-all temperature and void

coefficients are negative, making any power excursion self-limiting.

Tests of the shim rod system for controlling long-term reactivity effects and xenon poisoning have shown that strength of the system is in agreement with calculations and that the desired amount of reactivity control is readily available.

Performance of the fuel elements has caused little or no difficulty. Heat transfer properties of the elements are excellent, allowing fuel cores to operate at or below design temperatures. One UO_2 fuel element was equipped with thermocouple junctions in the centers of six of the 19 rods. During startup at 5 mw and again at 10 mw a decreasing temperature drop across the fuel element was monitored. This may indicate the desirable progress of in-reactor sintering. This occurred at temperatures much lower than observed in corresponding tests out of the reactor. This is the first large-scale experiment with swaged UO_2 fuel.

The power distribution with the present reactor fuel loading is in good agreement with predicted values. This distribution is characterized by a peak to average flux ratio of 1.3.

Measurement of the zircaloy process tubes for tube wall thickness and dimensions of the insulating gas gap around tubes has shown nothing adverse or unexpected.

Results of shielding tests run at low power levels indicate adequate shielding when extrapolated to 70 mw. Some neutron streaming through gas lines penetrating the bottom shield was found but localized cadmium shielding is expected to control this.

In general, no major design deficiencies that could impair the attainment of reactor safety or lifetime have been uncovered. Earlier problems concerning primary coolant quality have been resolved.

The use of plutonium as a reactor fuel enriching agent would substantially increase the amount of energy available from the world's supply of fissionable materials. Scientists and engineers working with the Plutonium Recycle Test Reactor will develop technology for using plutonium as a fuel and will seek to establish the economic feasibility of the plutonium recycle concept. All phases of the nuclear fuel cycle—including fuel fabrication, the relationship between plutonium fuel cycles and reactor concepts, and fuel reprocessing—are being studied in the plutonium recycle program.

DIRECT CONVERSION

A promise for the future

FOR YEARS UTILITY MEN have dreamed of the direct conversion of heat into electricity without the maze of steam generators, turbines, exciters, condensers and pumps on top of pumps. The recent developments in this field have been extremely exciting and the editors were privileged to sit down and talk with Dr. R. W. Pidd, manager of direct conversion program, General Atomic Division, General Dynamics Corp., a few weeks ago to discuss some of the success and some of the problems of this program. We think you will be interested in these questions and answers.

Q. Dr. Pidd, just what do you mean by direct conversion?

A. We mean conversion of heat directly to electricity with no intervening stages involving rotating machinery.

Q. What approaches are you taking toward direct conversion?

A. We have two primary approaches: thermoelectric and thermionic. Thermoelectric devices work on the same principle as a thermocouple—a temperature difference across a semiconductor material causes a current to flow. We have developed a number of converters that work on this principle including a panel for converting solar heat to electricity. At present, such devices are limited to service at temperatures under 600 C, but we are developing new materials that will permit operation up to 1,000 C which will make them useful with nuclear reactors. Thermionic converters, on the other hand, are inherently high temperature devices that operate on the same principle as the radio tube.

Q. Which phase of present investigations seems to offer the most promise for the power industry?

A. Without question the thermionic cell is most promising for real power. The cell has already had experimental success, giving 10% thermal efficiency while still in a very early experimental version.

Q. What is a thermionic cell?

A. It is a diode using uranium carbide as a cathode with cesium vapor added to create a conducting plasma. This diode, when heated, produces an electrical current. The cells tested to date have been operated in cores of test reactors. However, the cells of tomorrow can be grouped together into critical masses which will create their own heat source. A typical module of these cells the size of a single fuel element for today's high temperature gas-cooled reactor would produce about 100 kw of d-c electrical power.

Q. What fundamental research has to be done before this cell can become a commercial power producer?

A. With present knowledge, gained in a little less than four years, we can design a cell that is 20% efficient. It would operate at 1,850 C and reject heat at 900 C. Such a unit could be built as a "topper" element—its rejected 900 C heat would run a conventional steam plant. This would give a plant with an estimated over-all efficiency of 50%. With present metallurgical technology 1,850 C operation is now limited to about 1,000 hours.

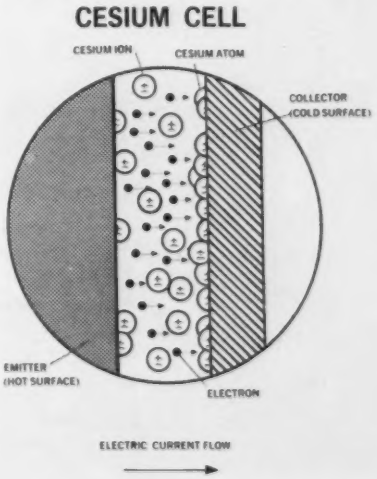
However, we believe the metallurgical problems will be licked and, once we have proven out a prototype plant, a power reactor could be very possible in the 1970s, or perhaps even sooner.

Tomorrow's cell, with further fundamental knowledge to be gained, working at 1,850 C input and 300 C out, giving an over-all efficiency of 45%, gives great hope of becoming the true direct converter in the power field.

The portion of General Atomic's direct conversion program relating to central station power applications is being carried on with support from the Rocky Mountain-Pacific Nuclear Research Group, composed of the following eight electric utility companies: Arizona Public Service Co., California Electric Power Co., Pacific Power & Light Co., Portland General Electric Co., Public Service Co. of Colorado, Public Service Co. of New Mexico, Utah Power & Light Co., and Washington Water Power Co.

Also supporting the direct conversion program is San Diego Gas & Electric Co.

This thermionic cell produces an electric current when heated. Later may be constructed to produce its own heat source



NUCLEAR LEADERS COMMENT

An Electrical West Seminar— The editors seek answers to questions concerning the future of the industry

We asked Dr. Seaborg, "At the present time, the AEC exercises both policy and regulatory functions in the power reactor field—that is, it has a reactor development program as well as licensing and safety regulations. Do you foresee a time when the AEC will turn the development and construction program over to the industry, retaining to itself only the regulatory powers?"

"The Atomic Energy Act of 1954 places upon the AEC the responsibility for 'the development, use and control of atomic energy to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.' These important responsibilities are in addition to, as stated in the act, 'the paramount objective of making the maximum contribution to the common defense and security.'

"Regulation of the uses of atomic energy is a basic element in the commission's responsibilities, and there must be an adequate regulatory program to protect the public interest. The other objectives of the Atomic Energy Act, however, are so important that I do not anticipate, for the foreseeable future (say, 10 years) that the AEC would limit its role in nuclear development solely to the regulation of the nuclear industry.

"The national interest requires that the United States maintain, and if possible improve, its place in the forefront of nuclear developmem. To achieve this objective, I believe that, for some time to come, there must be government sponsorship of research and development programs of such broad scope that individual industrial firms could not be expected to finance them.

"Of course, there will be areas for which responsibility can be assumed almost wholly by industry. As reactor designs become proven, industry can and should take over the task of putting nuclear power to work in the United States. But it is not enough to stop with a 'proven reactor.' We are at an early stage of reactor development, and it should be possible to make many significant advances in reactor design. The research and development, together with the design, construction and testing of new prototype reactors, will continue to be very expensive. I believe it is in the national interest to carry this work forward at a more rapid pace than industry alone could support.

"The commission also has responsibilities in such fields as physical research, biology and medicine, isotopes development, and training and education. Coordinated national programs in these areas are necessary to achieve the promise of the peaceful uses of atomic energy. I believe that the commission's program to foster international cooperation in nuclear development is also important.

"Adequate regulation must accompany the increasing use of atomic energy. Regulation is an essential aspect of the commission's responsibility to protect the public health and safety—and there is no responsibility that we take more seriously than this one. Just as other programs will change with time, so there may be an evolution in the commission's regulatory activities. Possibly, at some time in the future the commission's regulatory function may be given independent status in another government body. I doubt that it will ever be possible to eliminate the safety regulation of nuclear facilities, although the necessary regulations may be refined and narrowed as more experience is gained in the design, construction and operation of reactors. I also doubt that there will be a time when the research and developmental aspects of atomic energy will be placed entirely in private hands. The acceleration of our scientific progress is a national necessity, and it must be accomplished through the joint efforts of the government, industry, and our educational and research institutions."

DR. GLENN T. SEABORG, *Chairman, U. S. Atomic Energy Commission*

We asked Dr. Pittman, "Please outline the goals of the Atomic Energy Commission's Power Demonstration Reactor Program."

DR. FRANK PITTMAN, *Director, Division of Reactor Development, U. S. Atomic Energy Commission*

"At the present time nuclear power is produced in custom-built, complex plants that are costly to build and operate because of their requirements for special fuels, materials, safety and technology. The tremendous capital costs make it necessary for utilities to amortize nuclear stations as base-load power sources over the lifetime of the plants to achieve acceptable power costs.

"To make nuclear power competitive in the United States we must take full advantage of all the engineering and mechanical know-how of our science and industry to simplify design, to decrease construction costs, to increase thermal efficiencies, to make maximum use of fuel, and to minimize operation and maintenance costs. This job will not be accomplished overnight with the construction of a few experimental and prototype plants. It will only have been started when more power stations have been built and have reached equilibrium. Nevertheless, we are convinced that nuclear power can be a major factor in meeting the new generating requirements of the United States, and our nuclear development program stems from this conviction.

"The key to progress in nuclear power production is improved and demonstrated technology. We did not even know that some of our problems existed until atomic fission and turbogenerating equipment were first united for power production in 1951.

There was no need for materials capable of operating in an environment of extremely high temperature, pressure and radiation prior to the era of nuclear power and, without this need, vast areas of materials technology remained unexplored. Therefore, the emphasis of our program has been on the development of this technology, which can enable us to achieve increased capability in the generation of nuclear power.

"Concurrently with our development of materials we have had to determine the technical feasibility of various reactors and, after verifying this, determine the economics of each.

"The development program is carried out in commission, educational and private laboratories and through construction and operation of experimental and prototype reactors.

"Several reactor systems that appear to offer promise of producing economically competitive nuclear power are being examined. When classified according to coolants, the major reactor systems can be identified as light-water-cooled reactors (these include pressurized and boiling-water systems) and organic-cooled, sodium-cooled, gas-cooled and heavy-water-cooled reactors."

Source: Science, Vol. No. 133, No. 3464, by permission.

We asked Dr. Sigel, "Is there any one fundamental obstacle in the path of future development of the atomic power reactor program?"

"There appear to be no fundamental obstacles preventing the economic utilization of nuclear energy for the production of electric power. Technical problems that we faced 10 years ago in a number of systems now appear largely overcome as a result of the extensive development programs sponsored by government and industry. Satisfactory fuel materials, especially uranium oxide for water- and organic-cooled reactors, and uranium carbide for sodium-cooled systems have been developed. Coolant technology is well advanced. Operating experience with all of the U. S. power reactor types has been encouraging. During the development period there have been complex internal political considerations, and questions of international prestige, which have colored and to some degree influenced and even occasionally obscured the true status of nuclear energy in relation to the utility industry. Today, however, several systems appear capable of competing with the cost of energy from conventional sources in regions of the United States where fuel costs are high.

"The problem of sites for large nuclear power stations remains substantial, but may turn out to be less severe than for large conventional plants. Thermal stations having single units of 300 mwe and above, and designed to ultimately accommodate perhaps 1,200 mwe, must be located fairly near their populous load centers to avoid excessive transmission line costs. This requirement for proximity to the load center is frequently in conflict with other requirements arising from air pollution controls, need for large amounts of cooling water, and annual fuel transportation and supply in megaton quantities. As we gain more experience with the safety of nuclear plants, and better understand and accept their inherently safe features, the site problem for large stations may actually be alleviated. For example, underground location of a nuclear reactor and its radioactive heat transfer system should be feasible even within the confines of typical large cities. Such a location would simultaneously take care of the safety criteria for the nuclear plant, minimize transmission costs, avoid air pollution from combustion products, and eliminate major fuel transportation and storage problems of increasing severity in large conventional stations.

"I am convinced, therefore, that there are no significant technical or economic obstacles to the acceptance of nuclear power in a growing number of utility systems, and that in fact nuclear stations may eventually have fewer site problems than conventional stations."

DR. SIDNEY SIGEL, *Vice President, Atomics International Division, North American Aviation Inc.*

A statement from Dr. Fink's testimony before the Joint Committee on Atomic Energy.

"To help bring about widespread use and acceptance of nuclear power we need an enlightened and understanding public.

"To achieve this goal, we must answer searching questions that are sometimes asked by the public today.

"How safe are reactors? Can they be located on electric utility systems without peril to the public? Should nuclear plants be built only at locations remote from centers of population?

"These are legitimate questions. They must be faced. Public confidence cannot be built on ignorance or by hoping that the tough questions will somehow go away. As a businessman, I believe that a successful enterprise cannot be built except on the foundation of public understanding. Public apprehension can be more decisive than economics in the growth of the peaceful atom.

DR. LYMAN R. FINK, *General Manager, Atomic Products Division, General Electric*

"The general view of knowledgeable people is that the objective facts do warrant a high degree of assurance. Government and industry broadly have concluded that the national interest requires an aggressive effort to develop nuclear power as an integral part of the country's electric generating capability. I believe that a fully informed public would reach the same conclusions.

"Balanced presentations and considerations of a safety problem are necessary. Denial or minimizing of the problem would be unthinkable. At the same time, risks need to be evaluated objectively and placed in proper perspective. In the name of safety we could inflict greater harm by withholding the benefits of atomic energy.

"The public should be fully informed of the exhaustive and meticulous government safety reviews applied to licensed projects. They should understand the vital stake which the atomic industry in its own interest has in nuclear safety. They should be aware of the searching analyses and the development of standards for the safe operation and design of reactors. They should know, e.g., that Hanford is ten times as safe as the average of all industry. Irresponsible statements should not go unchallenged, otherwise Congress may not be able to spur the orderly growth of atomic power.

"The right paths will be taken and public confidence will be fortified through public enlightenment. To this objective we are glad to pledge our continued support. The task of informing the public candidly and fairly is a joint responsibility of industry, of the executive and legislative branches of government and of the engineering and scientific community."

THE FUTURE - - - AN APPRAISAL

In the grey areas, a race with transmission

THE FUTURE of nuclear power for the generation of electricity in the West will depend on the growth in the area's electric energy requirement and the relative price of nuclear power compared with fossil fuel power and availability of hydro.

Future Requirements

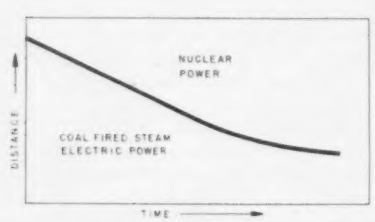
The growth of the Western states continues unabated with 1960 being another record year. The 1960 census showed 26.9 million persons living in the West, an increase of 7.3 million over the 1950 census. By 1975 the population of the West is expected to reach 39 million.

During 1960 this area produced 147 billion kwh from an installed electric generating capacity of 31 million kw. About 56% of this energy was produced at hydroelectric installations. The remaining portion was supplied from fossil fuels with natural gas being the largest contributor.

By 1975, the total electric energy requirements of the West are expected to reach 362 billion kwh and by 1990 should reach 891 billion kwh. Electric generating capacity in 1975 is estimated to be 72 million kw and 167 million kw by 1990.

To determine what the future holds for nuclear power it is first necessary to analyze the availability of the conventional methods for producing electricity.

One consideration is the potential for additional hydroelectric generating capacity. At the end of 1960 this area had 18 million kw of installed hydroelectric capacity. The Federal Power Commission reports that the total hydro potential in this area is 68 million kw. A part of the 50 million kw of undeveloped capacity cannot be economically developed.



As time goes by, distance from coal-fired steam generation becomes less important

Even if all of this potential were developed, it would meet only 40% of the total 1990 requirement.

Of the fossil fuels used for thermal generation, coal, oil and natural gas are now being used in sizable quantities. Although, at the present time in the West, coal ranks at the bottom of the list in usage, from the standpoint of reserves it is at the top. Estimated recoverable coal reserves in the West total about 330 billion tons. To visualize the magnitude of these reserves it is interesting to note that **this quantity of coal would supply the West's 1990 electric energy requirements for at least 740 years.**

Certainly some of this coal will be dedicated to uses other than the production of electricity, such as coking and higher uses of coal chemistry. It is also possible that a portion of this coal will be used in other parts of the country. Nevertheless, this coal reserve represents a tremendous energy source and nuclear power must compete with coal on the basis of **cost and not on the basis of a depletion of coal.**

Fossil Fuels

At the present time, oil and natural gas are the major fuels used for thermal generation. Reserves of these fuels are only about 1% of the coal reserves. These fuels are presently being transported into the West from other areas to supplement local supplies. Even with consideration of supplies of oil and gas from outside the West, it is doubtful that these fuels can compete with nuclear power in the long run because of other preferred uses, costs of transportation and relatively limited reserves.

In addition to the conventional fossil fuels, this area contains vast quantities of oil shale that constitute a major energy resource comparable to the area's coal reserve. However, at the present time only a small portion of this reserve is believed to be economically recoverable. For this reason, and because large commercial extractions of oil from shale have not been started, it is unlikely that oil shale will be a serious competitor of nuclear power.

The present uranium reserve, through the use of breeder reactors, is potentially a larger energy resource than coal, but not enough larger to make this the basis for the long-term superiority of nuclear power. For nuclear power to become a major source of electrical energy, it will have to win out on the basis of cost.

It is doubtful that nuclear power plants can compete with the bus bar cost of electricity produced at large steam-electric plants located at the West's major coal fields. However, the West's major load centers are not located at these fields and long-distance, high-voltage electric transmission is required to deliver electrical energy produced at the coal fields to the major load centers.

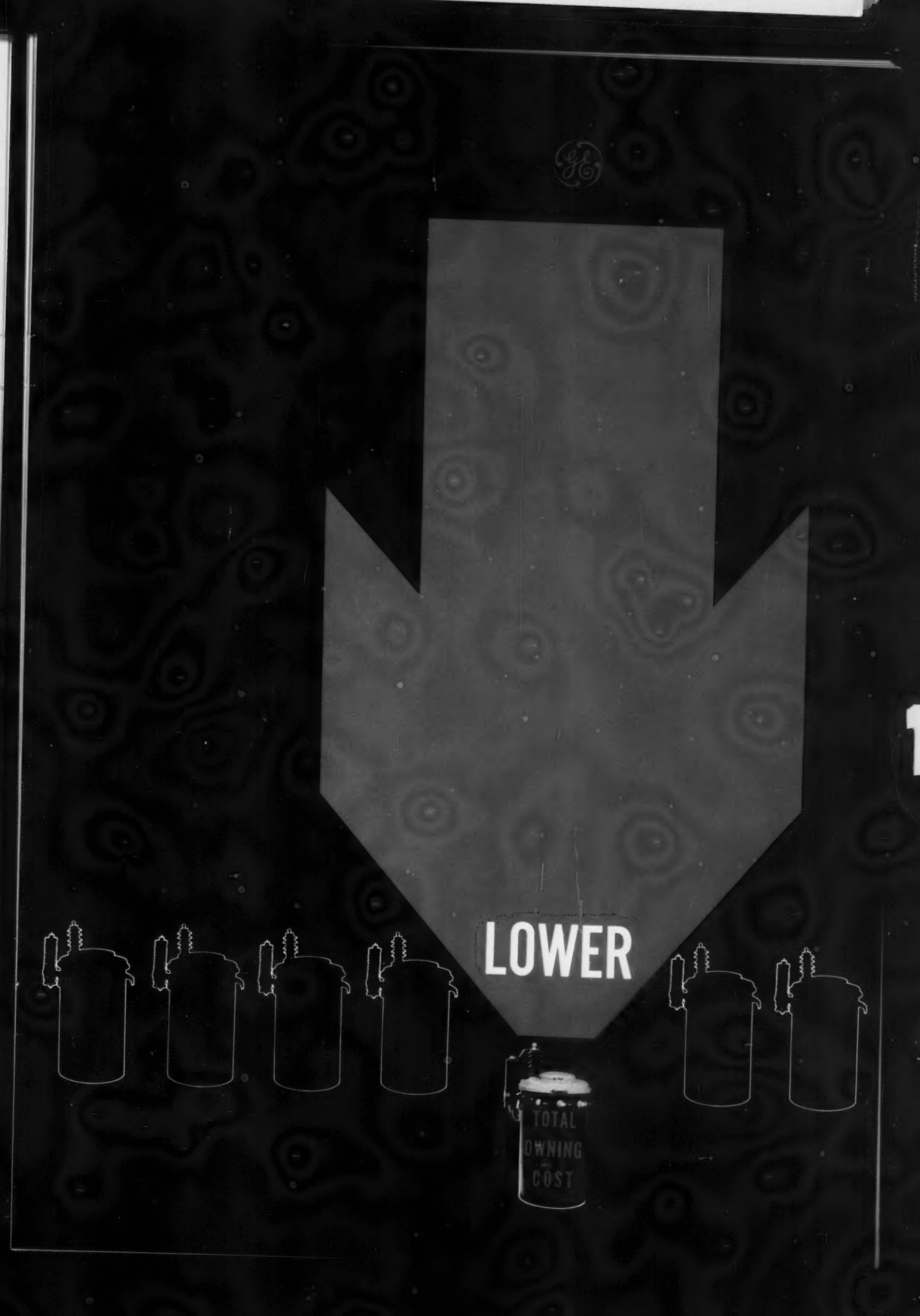
The choice may eventually become one of building large coal-fired plants located at the coal fields plus high-voltage transmission lines vs building nuclear plants located relatively close to the load centers.

The amount of nuclear power that can be expected in the future will depend on the advances made in reducing nuclear power costs vs advances in reducing the costs of EHV transmission. **Greater advances can probably be expected in reducing nuclear power costs than in reducing transmission costs, so time should favor nuclear power.**

The favorable cost of the 345-kv line from Four Corners to Phoenix now under construction by Arizona Public Service indicates that transmission line cost reductions are a long way from the ultimate.

The break-even point between the cost of electricity from a nuclear plant and the cost of electricity from a coal-fired plant may become one of distance between major load centers and major coal fields vs time as shown in the adjacent curve.

The West Coast, where most of the nuclear power development has taken place and where the distance to major fossil fuel sources is great, will be the first part of the West to find large nuclear power stations the most economical sources of electricity. By the same token the Rocky Mountain states, due to the large coal reserves located there and the shorter transmission distances to load centers, will not reach this point for many years.


LOWER
TOTAL
OWNING
COST

GENERAL ELECTRIC ANNOUNCES . . .

PERMALEX® 65 DISTRIBUTION TRANSFORMER

Switch to 65C operation enables utilities to take full advantage of General Electric's Permalex transformer insulation system . . . *with no change in operating practice*

GENERAL ELECTRIC

Forty pounds lighter and five inches shorter: this is how the 25-kva, 7200-volt PERMALEX 65 distribution transformer compares with its 55/65C predecessor. Similar reductions in size and weight are made on all PERMALEX 65 transformer ratings. This new, smaller, and lighter transformer offers substantial savings to electric utilities on "joint use" poles, as well as in installation, changeout, and inventory costs.

SMALLER SIZE, LIGHTER WEIGHT

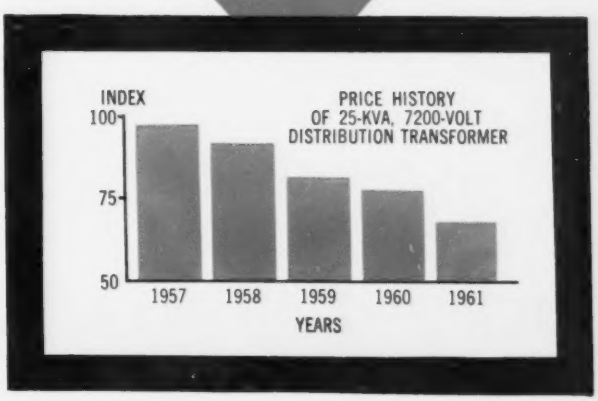
55/65C		65C
43 inches		38 inches
450 lbs.		410 lbs.

Redesign of General Electric's Permalex transformer into the single-rated PERMALEX 65 design also brings new reductions in utility distribution-system operating cost. Copper and iron losses have been lowered and, through lower impedance, regulation is improved. These improvements will help utilities meet increasing loads and their requirements for better voltage and service continuity—with greater economy and reliability.

LOWER OPERATING COSTS

With the introduction of the PERMALEX 65 distribution transformer, General Electric continues its program of passing manufacturing cost savings on to utilities in the form of lower purchase price. Chart of popular 25-kva, 7200-volt, no tap rating (below) illustrates how G.E.'s initiative in sharing cost savings has lowered utility capital expenditure on distribution transformers since 1957. Price reductions have been made on all PERMALEX 65 transformers in preferred-kva ratings.

LOWER PURCHASE PRICE



How General Electric insulation research paves the way to lower transformer total owning cost

Cyanoethylated kraft insulation, heart of G.E.'s transformer insulation system, was developed by skilled chemists in General Electric's distribution transformer insulation laboratory in Pittsfield, Mass. The new PERMALEX 65 design makes *full* use of G.E.'s thermally superior insulation system, permitting new reductions in size, weight, and purchase price of distribution transformers.

Lower total owning cost for distribution transformers is a prime General Electric objective. Historically, the stage was set for the 65C-rated transformer in May, 1959, when General Electric announced its high-temperature Permalex transformer insulation system. Then, in 1960, G.E. introduced its "dual-kva" rating. A second kva rating was assigned to Permalex transformers, based on 65C average winding rise. This served as an intermediate step to the development of today's single-rated 65C unit.

General Electric's new PERMALEX 65 transformers cost less to purchase, to install, to operate, and to change out. *This* is Lower Total Owning Cost. Your G-E sales engineer has the complete story. Section 482-25, General Electric Company, Schenectady 5, N. Y.

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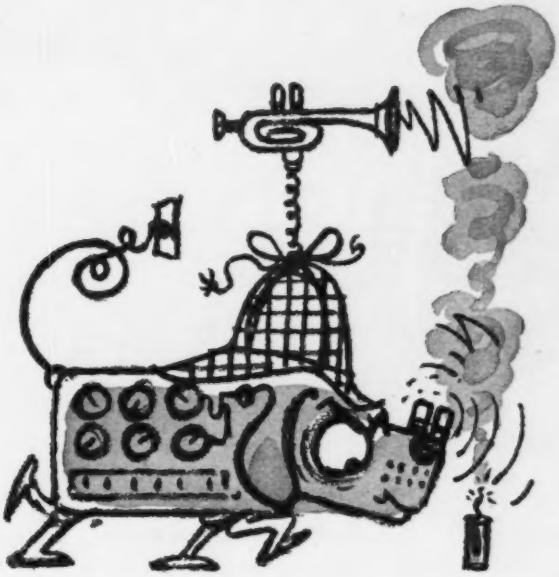
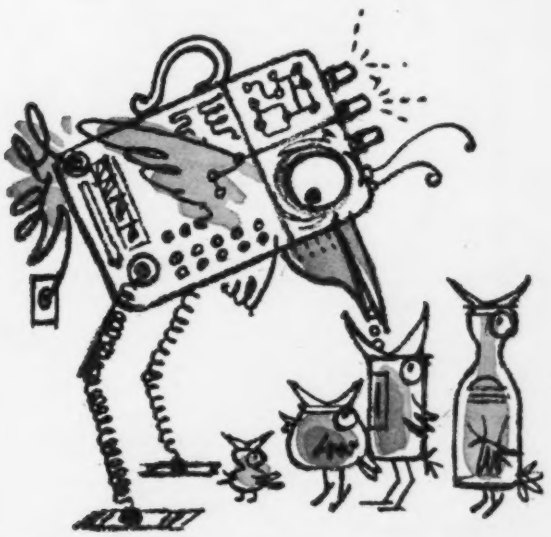
modernize with an electronic "THINGAMAJIG"!



PHOTOELECTRIC SNIFFERS smell out smoke—then summon the fire brigade, turn off ventilation systems, turn on sprinklers, shut down equipment, even close doors.

ULTRASONIC SCRUBBERS clean tiny component parts fast. This beats slow and costly old-fashioned ways, solves problem for precision equipment makers.



AUTOMATIC FILLER-UPPERS fill all types of containers accurately and quickly—even measure and mix liquids. Perfect for beverages, chemicals, drugs, foods...

ELECTRONIC COUNTERS count anything — hippos to hula hoops... tackle practically any counting problem with ease. Lots of industries are adopting them.

There are thousands of electronic devices that make work easier, safer and more productive. Call us for information on "thingamajigs" that apply in your field.

P·G and E·
Pacific Gas and Electric Company

DON'T LET "LINEMAN FATIGUE" ROB

Here's how the Kearney Power-operated Tool works

After correctly positioning the Kearney Power-operated Tool on the connector, the lineman squeezes a small rubber bulb conveniently attached to his belt. Air pressure from the bulb closes a switch to start a small motor-driven hydraulic pump on the ground. High-dielectric hydraulic fluid flows through a non-conducting pressure hose, advancing the ram and closing the dies to make the indent. To retract the dies, the lineman simply releases his finger pressure on the bulb.

An optional hand switch control is also available which permits an operator on the ground to control the pump on signal from the lineman making the installation.

YOU OF VALUABLE MAN-HOURS!

Kearney Power-operated Tools take the "muscle" out of compression installations, increase work output, reduce labor costs... and often pay for themselves in a month or less!

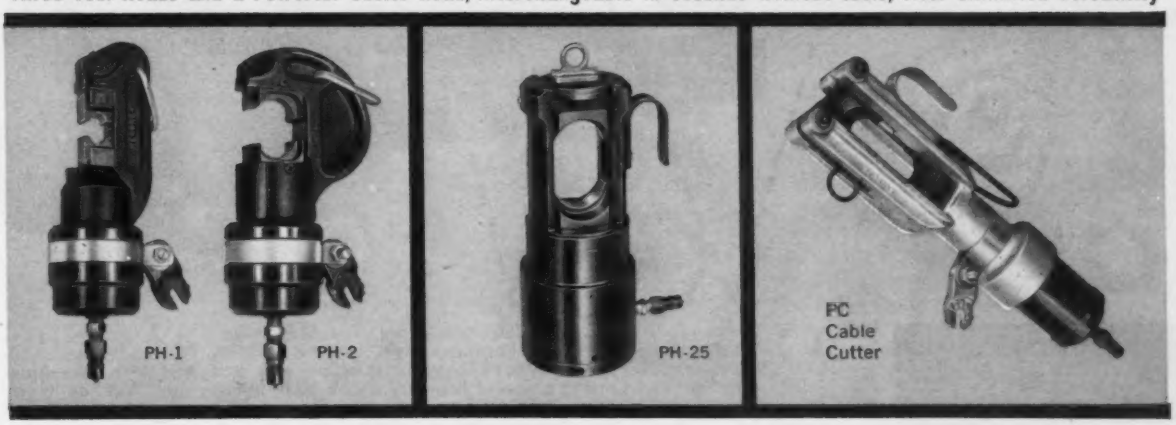
Kearney Power-operated Hydraulic Compression Tools make fast, light work of any compression fitting installation... *hot* or *cold*. By simplifying installation and reducing lineman fatigue, Kearney Power-operated Tools enable power companies to effect sizeable reductions in compression connector installation costs.

In use, the lineman merely positions the Kearney Tool on the connector and squeezes a small rubber bulb to actuate a portable motor-driven hydraulic pump on the ground below. The Kearney Power-operated Tool does the rest, without further lineman effort other than to reposition the tool for the next indent. Complete compression of the fitting can be made in less than 30% of the time ordinarily required by a lineman using the most efficient hand-operated tool.

Kearney PH-1 and PH-2 Power-operated Compression Tool Heads and the Power-operated Cable Cutter can be hotstick-mounted to make installations on energized conductor... or they can be hand-held for cold work. Using Kearney hotstick-mounted Power-operated Tools, linemen can install connectors, deadends, or sleeves... and cut ACSR or standard conductor up to 1½" in diameter... at *any* angle... with greater speed... at greater distances from the pole... and with greater safety when working on energized lines ... than has ever before been possible with hand-operated tools.

An investment in Kearney Power-operated Hydraulic Compression Tools will quickly pay for itself in labor savings and increased work output. A demonstration will convince you.

Three Tool Heads and a Powerful Cutter Head, interchangeable in seconds without tools, offer unlimited versatility



The Kearney PH-1 and PH-2 power-operated indenting heads shown above use the same dies as Kearney WH-1 and WH-2 hand-operated hydraulic tools... differ only in their maximum working ranges. For instance, the PH-1 Tool accommodates a range of aluminum Squeezon compression connectors for wire sizes up to a maximum of 4/0 ACSR or strand, while the PH-2 installs Squeezons on conductors as large as 397.5 ACSR or 400 strand. Dies may be easily inserted or removed without tools.

The Kearney PH-25 Tool Head installs a full range of compression fittings, from the smallest Squeezon up to a maximum of 1,192.5 MCM. With this tool a wide variety of fittings can be compressed with half the number of indents normally required using other types of tools. Tool develops 21 tons of thrust. Cutting dies are available for use with the PH-25 to cut conductor up to 1,500 MCM.

The Kearney Power-operated Cable Cutter cuts any type of conductor up to 1½" diameter, in 30 seconds or less. Saves many valuable man-hours otherwise lost in hand-sawing. Produces a clean-edged cut... saves deburring. Cutter may be hand-held for cold operation or hotstick-mounted for use on energized lines. Cable cutter and PH-1 or PH-2 Tool Heads can be interchanged in seconds. Cutter can also be used to cut ground rods, guy wires and like materials... on the ground... or on the pole.

In the West: For Complete Information, contact your nearest James R. Kearney Corporation Sales Office

1299 Bayshore Highway, Burlingame, Calif. Phone: Diamond 2-9489 • 430 Foothill Blvd., La Canada, Calif. Phone: MUrray 1-1026, SYlvan 0-2933 • 1525 N. Highway, St. Helens, Ore. Phone: St. Helens 1088

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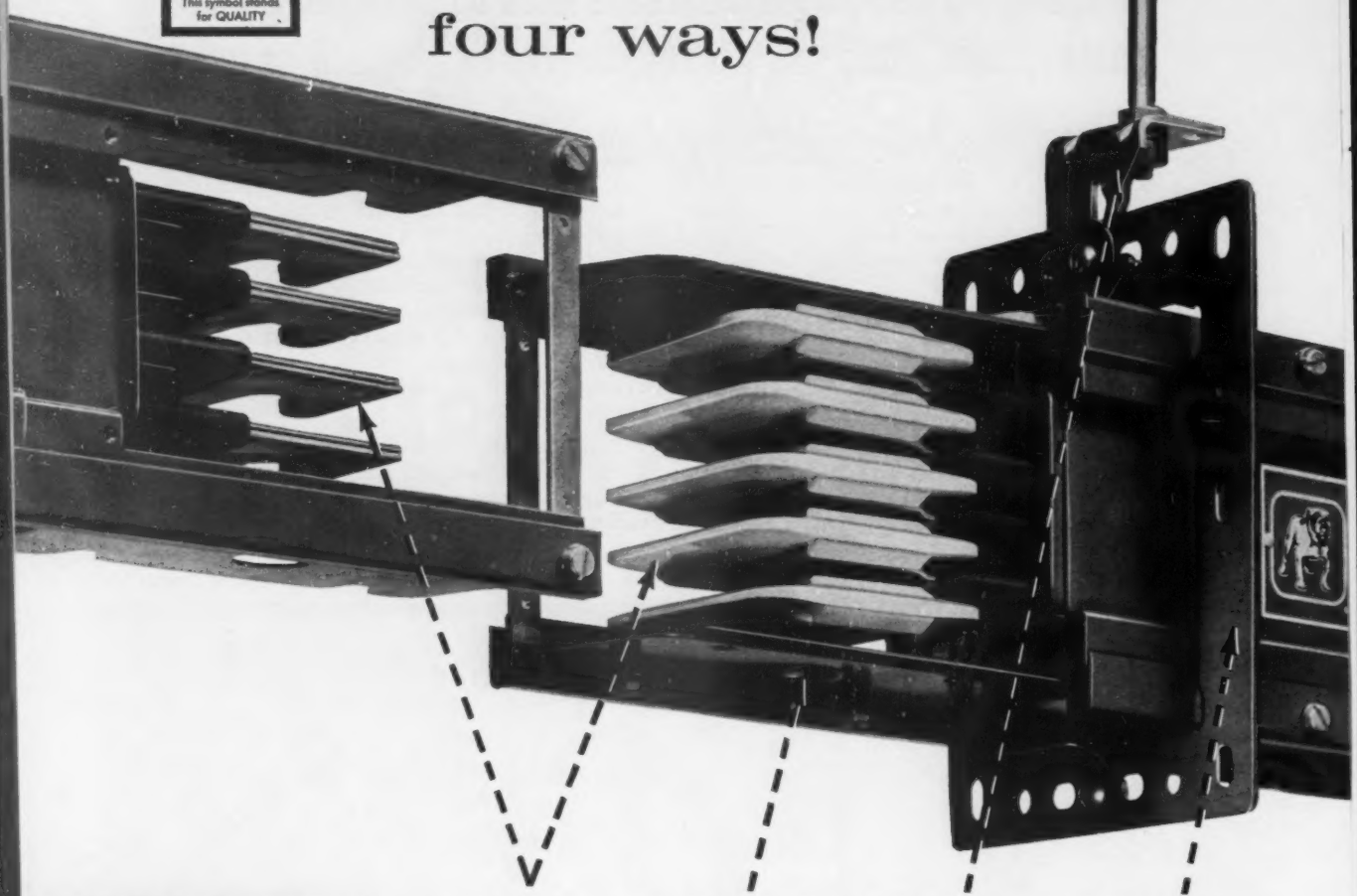
This symbol stands for bus duct

This symbol stands for QUALITY

XL Bus Duct by BullDog

Makes light work of installation four ways!

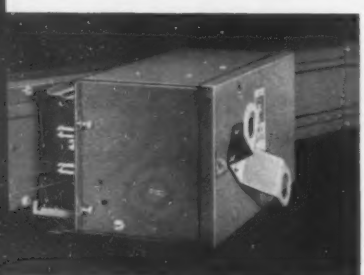


1 *Keyed ends* of plated aluminum bars align automatically, join as fast as sections can be handled.

2 *Single integral bolt* spins tight quickly to secure bars under a ton of pressure. Captive screws join casings together.

3 *New* HANGFAST *Adapter* bolts to suspension rod fast ...duct with standard hanger is instantly hooked and secured.

4 *Lightweight*, rigidly-made 10-foot sections require only *half* as many hangers as ordinary duct.



PLUG-IN SAFETY—Self-supporting XL Safety Plug hooks to duct, leaving workman's hands free to complete electrical plug-in with utmost ease and safety.

BullDog, the creator of plug-in bus duct, has for years assisted industrial plant operations by providing high performance, efficiency, flexibility and dependability in power distribution. Then BullDog went one step further . . . developed XL BUStribution® Duct to make installation and handling easier than ever before, as shown above. At the same time, BullDog incorporated foolproof dead-front safety as well as other features ensuring that workmen plug in for power the safe way *only!*

Ask your BullDog representative to show you all these XL Duct installation and safety advantages. He can also provide complete information about BullDog BD plug-in duct, LO-X® plug-in duct and LO-X feeder duct.

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Mich. In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 East 40th St., New York 16, N.Y.

Consult the following Pacific Coast representatives:

Const Electric & Manufacturing Co.
1733 N. E. Seventh Ave., P. O. Box 7866
Portland 12, Oregon

Young Electric & Mfg. Co.
2134 Curtis St.
Denver 2, Colorado

Safety Switchboard Company
910-89th Avenue
Oakland 21, California

BullDog Elec. Prod. Co. of Los Angeles
3020 Supply Ave.
Los Angeles 22, California

I-T-E CIRCUIT BREAKER COMPANY
BULLDOG ELECTRIC PRODUCTS DIVISION

ELECTRICAL WEST
SEPTEMBER 1961

CONTRACTING & CONSTRUCTION SECTION

STATISTICS / COSTS / PROPOSED PROJECTS / NEW PRODUCTS / NEWS

LATE NEWS FLASHES

More Wage Increases

While the San Bernardino Division of NECA, Southern California Chapter, and Local 477, IBEW, settled on a three-year agreement, both the Los Angeles and Riverside scales went to the Council on Industrial Relations for settlement. In San Bernardino the rate goes to $4.90 per hour the first year, a 25¢ increase, and 12¢ increments each six months of the two succeeding years. Linemen's scale will be the same as wiremen but with an increase from 18 to 20¢ per air line traveling expense. . . Other disputed cases that went to the council from the West included Bakersfield and Stockton, Calif., Colorado Springs, Colo., Seattle, Wash., and Casper, Wyo. Announcement of settlements had yet to be made.

Management Forum for EASA

Region 14 annual conference of Electrical Apparatus Service Assn. (formerly NISA) will be staged at the Charter House Hotel near Disneyland, Anaheim, Sept. 22-23, close to the new national president's home area. George Larsen, Larsen-Hogue Electric of Los Angeles, is national president; H. D. Stump is president of the Los Angeles host chapter. "Management for Tomorrow," the theme of the meeting, will cover three areas—shop management, office management and shop layout—with speakers from successful shop operators and outside consulting management people. A management forum will be one of the highlights of the meeting.

1962 Code Amendments Ready

Copies of the "Proposed Amendments to the 1959 National Electical Code" are now available in printed form from NFPA, 60 Batterymarch St., Boston 10, at $2.50 each. They will form the

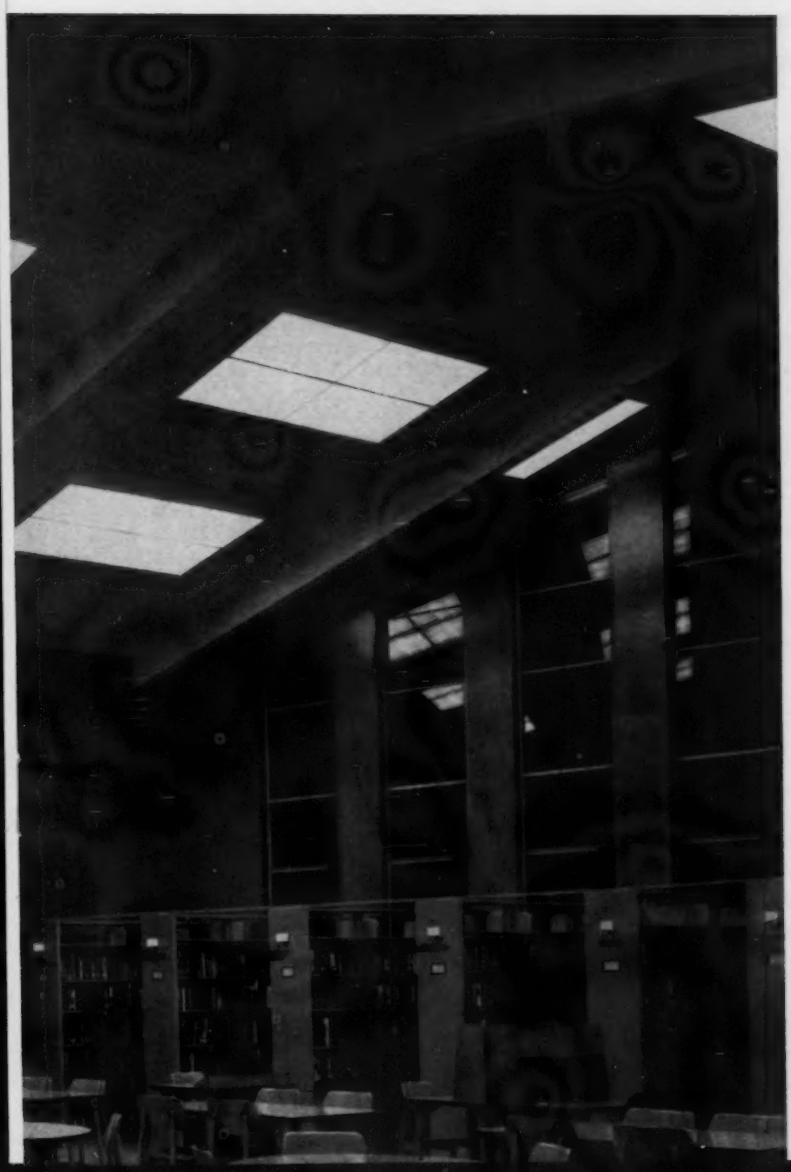
(Continued on page 126)

Page 115 NEW PRODUCTS
ESTIMATOR'S GUIDE
122 PROPOSED WESTERN PROJECTS
121 READER SERVICE SECTION

In modern schools such as this, where fixtures are selected for esthetic as well as functional reasons, Day-Brite lighting is the logical choice for creating a pleasant, efficient environment for learning.

The ceiling of the library's main reading room slopes from a height of 22 feet at the center down to 14 feet at the walls. DAYLUME® surface mounted elements maintain 85 to 90 footcandles at reading level.

Sierra Union High School, Auberry, California
Architect: *Alastair Simpson*
Consulting Electrical Engineer: *Edward Lowe*



How Day-Brite helps light the way to learning

The designers of this modern high school wanted the library to be the most attractive building on the campus . . . to encourage students to *use* it.

Good lighting, of course, was a *must*. High, sloping ceilings might have presented a problem . . . especially since suspended fixtures would have marred the clean, uncluttered architectural effect. And structural limitations eliminated any possibility of using recessed equipment.

The solution: shallow DAYLUMES® by Day-Brite because they provide . . .

Recessed appearance with surface mounting flexibility;

High-level, uniform over-all illumination;

And "Decidedly Better" Day-Brite dependability and ease of maintenance.

Got a school lighting problem?

Talk to the people with the most experience in solving them. Call your Day-Brite representative. *Day-Brite Lighting, Inc., St. Louis 15, Mo., and Santa Clara, Calif. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ont.*

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NATION'S LARGEST MANUFACTURER OF
COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

Motors and Controls—XXIV

SUMMING IT UP

TOM HUGHES, CALIFORNIA DEPARTMENT OF INDUSTRIAL SAFETY

We have covered a lot of ground in this series—material that has taken the author 40 years to assimilate. So we know that the salient features must be sorted out and brought together in a short summary. Some readers may be disappointed that we haven't actually worked any problems and made any specific applications but the field of application is so vast that this would be fruitless.

If you have read the whole series you will recall that we started with the load. Accelerating the load and then carrying it in steady running are two factors in producing heat in the motor. Since frequent starting or constant change in acceleration are our greatest problem in motor applications today, we emphasized the importance of the inertia of the motor. For frequent starts, choose the smallest motor possible (in mass —not horsepower) and gear it down.

Then we discussed the proper choice of winding characteristics. Manufacturers have produced many torque-vs-starting-current characteristics and can match some motor type to any duty cycle if we will just consult their application engineers. For those tough duty cycles such as frequent starts or frequent choke downs below the running speed (like you have in crushing or milling operations) the motor must be properly chosen.

The objective is to choose the motor so it will never get hot under normal duty cycle—assuming of course that we give it a chance by proper placing and ventilation. As for the horsepower required: on most loads today it will be a matter of cut-and-try. Pick out an available motor (maybe a loaner from a motor shop) of ample size and the correct speed. Make a temporary hookup to the load and then measure its input with electrical instruments.

By this means you can even make a rough chart of the duty cycle, remembering, of course, that the characteristics of your tryout motor will probably vary the results. Of course, on many steady loads such as centrifugal pumps or blowers the horsepower requirements can be computed fairly accurately from curves or tables without connecting a tryout motor. When the horsepower needs and duty character of the load are at hand our surest course is to consult the application engineer.

Since most of our modern machines are coming with the motor attached, the next problem is the overload protection. Here is where our troubles start, if the machine is something recently developed and no established habitat. As an example, the habitat of cranes, elevators, machine tools, bakery and laundry machines, etc., has been long established and the manufacturer knows the ambient temperatures to be met with in the only locations these machines can be used.

On the other hand, refrigeration or air compressors, water pumps, blowers, conveyor motors, milling machinery, etc., can be stuck in some awful holes or up against boilers or ovens, stuff stacked in piles against them, and the running protection is usually in a different ambient. In fact, the starter and running protection are usually furnished by the user. So here is where we really have to get down to business with all the details of proper application. Even if the manufacturer furnished starter and everything, you may start out with nuisance tripping and we must go to work on the project.

As to actual heating in the motor, manufacturers will show models in their catalogs than can stand 50 C or more rise over ambient. We feel that it is poor engineering to make such an approach. The only actual reason for developing such a motor (aside from special totally enclosed requirements) is to cram the works into a smaller case. A simple physics course will teach you that you don't make such heat without paying for it at the meter. And don't forget: you may have to pay for some fancy air conditioning to chase all that heat out of the building again.

We have always felt that if you can't hold your hand on a motor for two or three seconds without getting burnt there is something wrong in the setup. So we get the motor right and then go at the running protection.

Now remember we stated that the operating characteristics of different types of overload relays in different manufacturers' lines are quite overlapping. So our summing up their choice here is just to point out the most general trend and not to detract from the application methods of any manufacturer. So here we go again.

The normal thermal and bimetallic relay is a nice neat foolproof device for proper application to a large share of steady running, infrequent starting loads. The relay manufacturer's recommendations must be studied for adjusting to ambient conditions. This may mean using a heater size larger than that found in the table (pasted in the cover of the starter) or it may even call for a smaller size if the motor is in a hotter place than the starter.

Where ambient conditions are a ticklish problem the experienced application engineer may find the thermal, melting-alloy relay will give a more accurate performance. In general, however, it will be applied to the same load conditions that the bimetallic relay is properly applied to. It is a little faster in response than the bimetallic.

The magnetic relays (instantaneous or dashpot types) are usually applied where more money is involved in machinery, motor or product. They are more versatile in shaping to peculiar duties: quick to act and freer from nuisance tripping. They are not so subject to influence by ambients or to deterioration of elements by continuous heating and cooling and they have no "thermal memory."

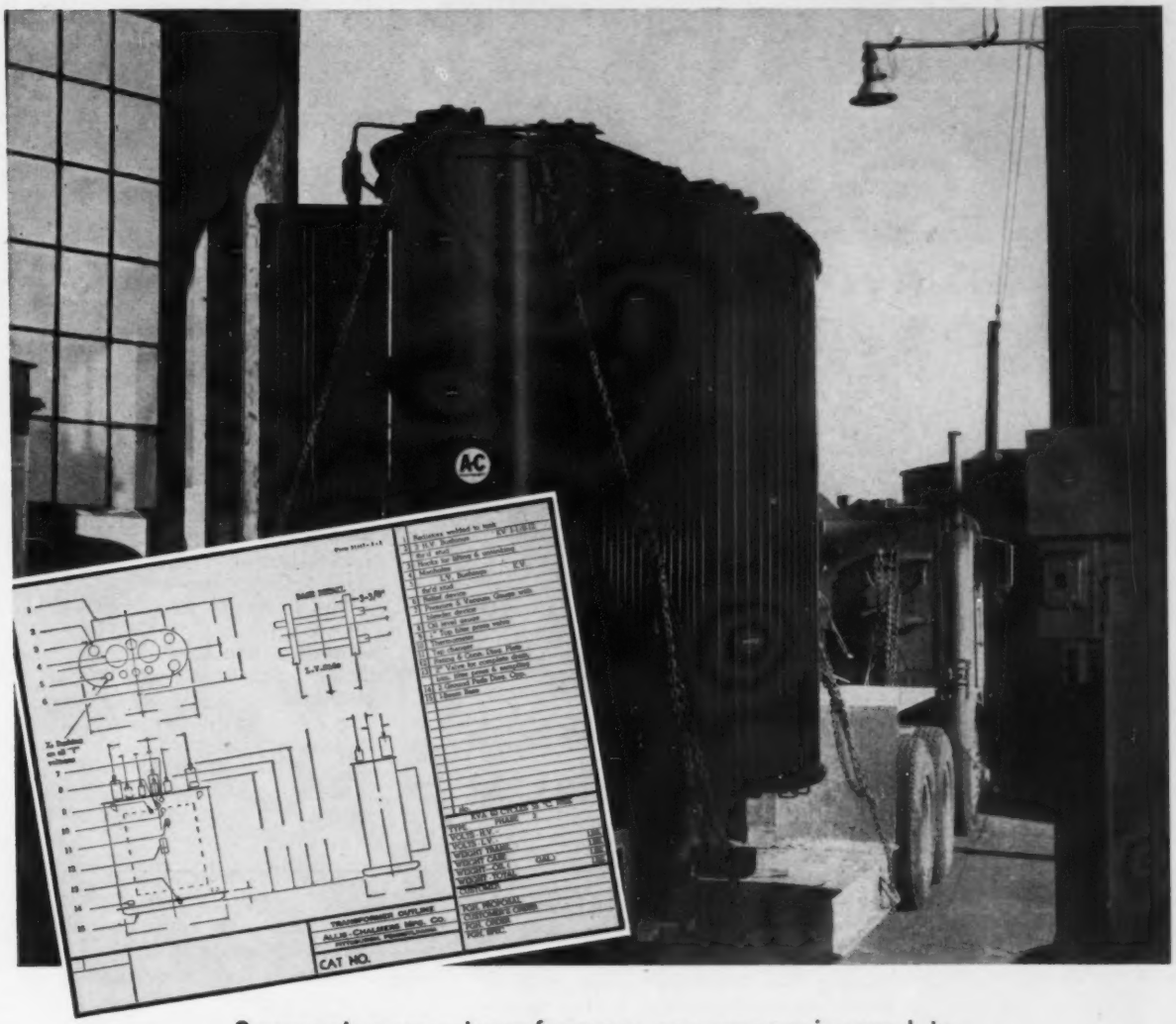
Magnetic relays are most valuable in circumstances where the motor is continually accelerating and thermal memory rules out thermal types; or where there are features of the load or driven mechanism that may jamb or overshoot. Where the prospect of serious destruction demands instant response the instantaneous magnetic (nondashpot type) is the only answer.

It is usually used with a motor that doesn't overheat under normal duty and no thermal or sensing-of-temperature elements are required. However, it can always be applied in conjunction with other types of relays or motors with inherent protection. But none of these remotely situated protective devices can furnish the unconditional insurance against unforeseen events that inherent motor protection (heat-sensing devices inserted in the winding) provide.

We know that there are many motors that spend their life time running an overhead blower (out of reach of man-made eventualities)

ALLIS-CHALMERS

A-1437



Compact power transformers are pre-engineered to

simplify your station planning!

Advance engineering information for customers — actual outline drawings (shown above) with certified dimensions and weights — is sent with every A-C small power transformer quotation. With this information, you can *immediately* plan your station layout — figure foundation sizes, mounting details. No time-consuming preliminary engineering.

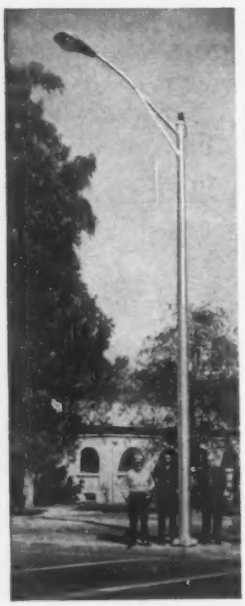
And no delivery delays! Pre-engineered major components are stocked. Your small power transformers are scheduled for manufacture as soon as your order is received. Installation costs are lower too. Low height—easier handling due to low center of gravity. Less weight — more economical pad or pier foundations. Low noise level — ideal for residential areas. Maintenance? Much simpler, with no external dirt-catching tank bracing.

These compact power transformers are available in 7500 kva and below, 69 kv and lower. See your nearby A-C office for details or write **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.*

For phone number of closest representative see advertising index in back of book.

WHAT A DIFFERENCE!

What a beautiful difference
P & K ALL-ALUMINUM
LIGHTING STANDARDS
can make in any community



You're looking down Broadway, the main business street of Needles, California. Ordered by the City Council as part of a relighting program, the installation, made by the California-Pacific Utilities Co., consisted of twenty seven P & K 30 foot tapered aluminum lighting standards. As you can see from the photos above, the difference is immediately apparent. The result is greater safety for the community at night and the beautiful modern appearance of the new standards by day. Of course, no painting ever required. Why not write for P & K's new brochure ALS-5 for a wealth of helpful information in your street lighting plans.

P&K

PFAFF & KENDALL
84 Foundry Street, Newark 5, N. J.

Branch Sales Office: San Jose, California
In Canada: Powerlite Devices LTD., Toronto, Montreal, Vancouver
Export Representative: Philips Export Co., N. Y., N. Y.

or a continuous running water pump in a nice clean engine room, etc. Such applications merit only the most simple types of protection. In other words, with properly applied motor, the calculated risk is practically nil. And there are such machines as air compressors and rural water pressure system pumps that come with both the motor and automatic pressure controller built in. They don't need a separate and remote controller supplied by the user but they do need some form of running protection.

Such equipment needs only a branch circuit switch and this is a typical application for dual-element (time-lag) fuses as running overload protection and branch circuit short-circuit protection, combined.

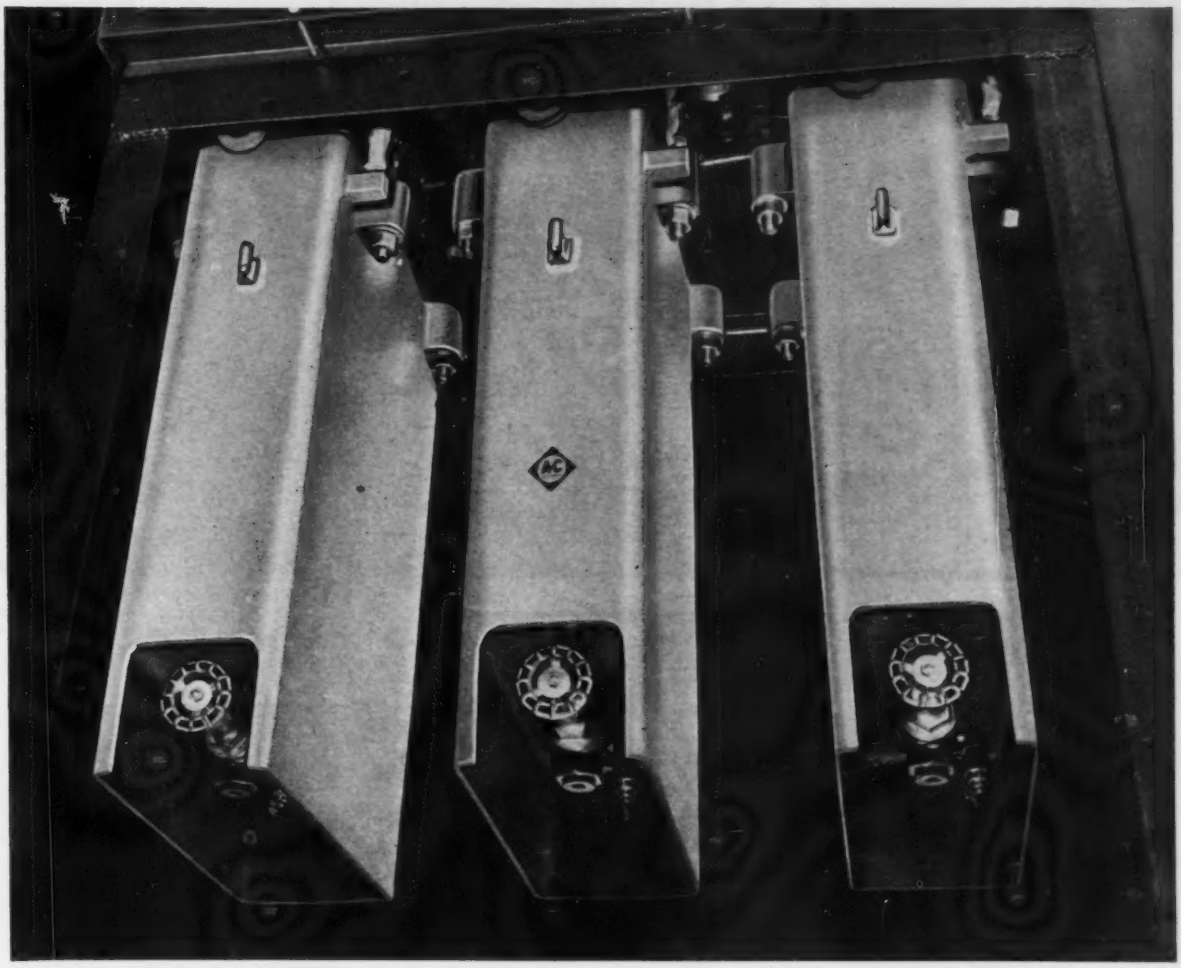
However, these simple applications we have just been talking about are becoming the exception instead of the normal. When motors first took the place of the horse they were given as much consideration as the good old farm work horse. Now, however, they are given less consideration than the poor rodeo pony. In fact they don't even command as much concern as the slaves that built the pyramids. They are just a number in a chart or table and no one even checks the grease in their bearings any more.

So the only sure answer is inherent heat-sensing protection and motors with this built-in feature are going to be standard specification before we see the end of the '60s.

Editor's Note—This is the last of the series on motor protection by Tom Hughes, a series bringing forth much new "inside" information on motor breakdown causes as seen from the user's viewpoint and as discovered in field experience by a searching minded safety engineer. Much of it is not yet to be found in texts or handbooks. It has been a valuable series to follow and to accumulate for future reference. Without means of gaging any demand for reprints the expense of holding the type was not justified. Therefore there are no reprints available. Only by photostating the pages on order will such reprints be available.

Next month a new development in motor protection from corrosive or wet environments will be explained. The epoxy encapsulated motor will be discussed and its field of application explored in another valuable article in the October industrial and lighting issue. Akin to the thermal protection of motors will also be an article on ballasts.

ALLIS-CHALMERS



Absolute phase isolation

...available on 14.4 and 23-kv outdoor distribution breakers!

Three-tank construction is a must for transmission circuit breakers to prevent phase-to-phase flashover. A-C gives you this same positive-protection, three-tank construction in 14.4 and 23-kv breakers.

Allis-Chalmers breaker protection extends even further! Each tank is lined with high dielectric insulation. Liners are nonbuckling, nonwarping.

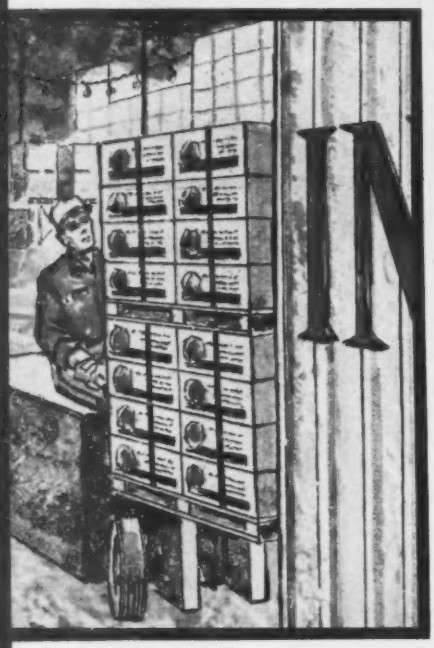
Three-tank design cuts oil contamination and maintenance, since only the faulted phase is affected. And new Type LO cross-blast interrupters (250 and 500 mva) minimize oil contamination even further by reducing interrupting time to *5 cycles* over the *entire* range of interrupting currents (up to 25,000 amps).

Type OZ breakers are available in 600 and 1200-ampere continuous-current ratings. Your nearby A-C office can give you full details, or request Bulletin 71B9705 from **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1425

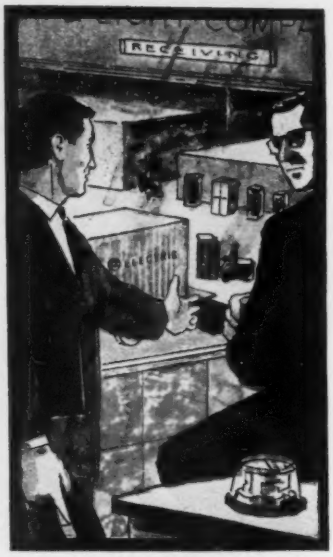
Two rugged, cross-blast interrupters per phase reduce arcing time to less than 5 cycles — sharply cut oil contamination.

For phone number of closest representative see advertising index in back of book.

JET STREAM SERVICE is a unique, automatic warehousing system that assures you of immediate delivery on standard high-volume meters, sockets, instrument transformers. ▼



◀ STATISTICAL SAMPLE TESTING SEMINARS provide utilities with an idea-center for discussion of statistical techniques.



▲ LOCAL PERSONALIZED SALES-SERVICE provides experienced metering personnel, specialized services, extensive facilities on a day-to-day basis.

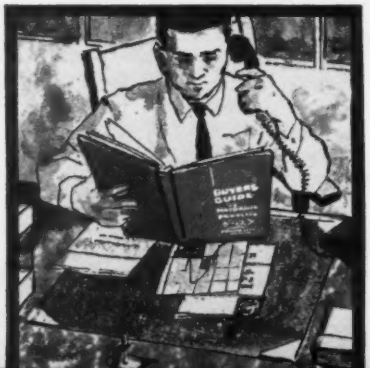
▲ CERTIFIED QUALITY program assures meter accuracy and reliability—average accuracy within 0.1% of reference kilowatt hour, 99.9% free of defects.

▲ APPLICATION ASSISTANCE helps in the correct selection of equipment, solving of metering problems.

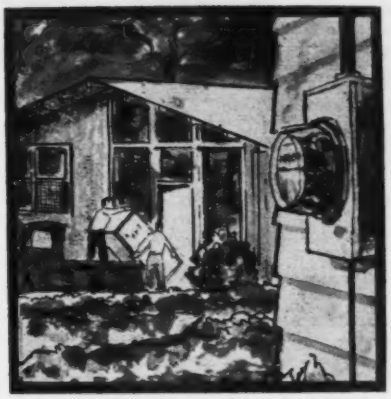
▲ PRODUCT SERVICE aims at full customer satisfaction in any problem area; supplies technical data and assistance.

◀ METER COURSES teach basic information—and new advances—on single- and polyphase meters, help utilities cut training costs.

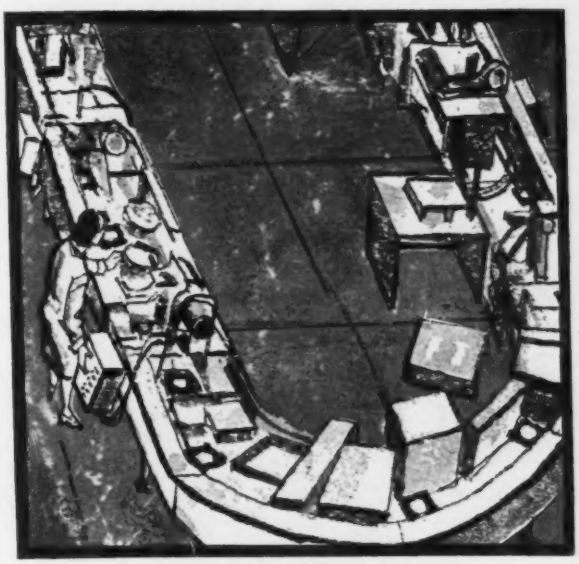
INDUSTRY COMMUNICATION—G. E. disseminates metering information of all kinds—technical, informative, statistical—to keep utilities abreast of new developments. ▶



You get all 10 metering extras from General Electric



LOAD BUILDING helps utilities in long-range expansion efforts—has long been supported by G. E. through programs such as Live Better Electrically, Medallion Homes, Residential Market Development.



LOW COST PER KVA results from advanced automated techniques, leadership in meter research and design.

The complete value of a metering purchase is not measured in product alone. The service a manufacturer supplies to meet utility needs, help solve utility problems, also represents substantial bonus value.

You see on the left a select group of the metering services General Electric provides the electric utility industry—10 valuable extras that cover the complete range of metering needs. Many of these extras go beyond the usual customer service; many have led the way for what is now accepted industry practice; many are exclusive with General Electric. Evaluate these metering extras in light of your own use. Measure the cost if you were to supply these services yourself. This is their worth to you.

Considering over-all value, what do these metering extras mean to you? Just this. When you buy General Electric, you get the best possible metering buy. General Electric's unmatched service package, teamed with industry's most advanced metering products, including such vital accessories as butyl-molded instrument transformers and meter sockets, means your metering dollar goes further, buys more, provides you with greater value than available elsewhere. For example, consider the product innovations pioneered by General Electric in single-phase meters.

- Magnetic-suspension bearing system—Between 1948 and 1960, more than 13,000,000 G-E magnetic-suspension meters were produced and in service on utility lines before other meter manufacturers adopted a form of magnetic bearing system.
- Steadily increased capacity—The capacity of G-E standard 3-wire, socket-type single-phase meters has more than tripled in recent years; yet, the cost per KVA of meter capacity has dropped from $0.98 to $0.32 just since 1954.

Before you place your next metering equipment order, measure the whole package — product and service. Then specify General Electric for today's most complete metering value . . . your best buy. 713-08

Progress Is Our Most Important Product

GENERAL ELECTRIC

MANUFACTURERS AND DISTRIBUTORS

Frank

Gaiennie

Holan Men In West

Two Holan executives—Daryl E. Gaiennie, leader of the live-line bare-hand team, and Arthur C. Frank, Timpte Division sales manager—will tour the West in October to help utilities set up the new method of working on energized lines.

The team can work on 34.5 to 138-kv lines, performing such work as installing compression repair sleeves, bundled conductor spacers, temporary jumpers, insulators, shunt splices and armor rods. More than 46 man-hours were saved at one work site on tasks necessary for energizing a 138-kv major substation, the manufacturer states.

Incorporating an insulated aerial lift, the method isolates the man from the ground and makes him as safe as the birds that perch on live wires. The lineman works in a fiber glass bucket lined with metal mesh that is connected by metal clamps to the energized line.

While in the West, the two men will coordinate efforts of utilities and safety groups in setting up new work procedures and regulations; solicit utility equipment requirements for incorporation in future designs; secure utility personnel training requirements before setting up a training program; help establish testing standards for bare-hand equipment.

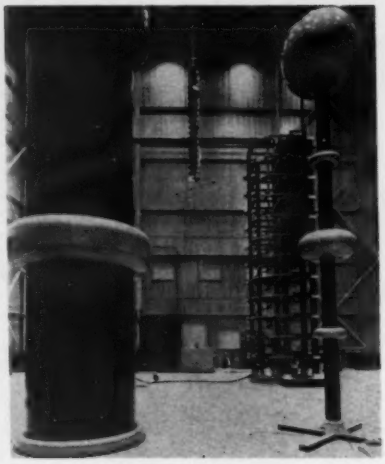
► **Phelps Dodge Copper Products** Corp. has appointed **Robert A. Webb** as manager of utility sales, replacing **Carl D. Dimity**, assistant vice president.

Delta Star Expands Western Plant

Delta Star has tripled its Western transformer manufacturing capacity in a move from San Carlos to Belmont, Calif. The new plant at 1777 Industrial Way provides a modern 60,000-sq-ft production facility and 5,000 sq ft of office space on a five-acre site that will allow for further expansion.

Delta-Star Division produced its first Western-built distribution transformer in October 1959 and, according to James W. Mahoney, Western region vice president of H. K. Porter Co., the enlarged facilities are "clear evidence" of the sales success enjoyed here.

He said that acquisition of the new site had led to serious consideration of producing in the West other Delta Star products now made only in the East. Initially, he said, attention will be focused on tooling up for the recently announced DS-50 transformer line, which incorporates the first production use of aluminum strip for low-voltage winding in the coil and has an all new stress-free core.



HIGH-VOLTAGE laboratory at A. B. Chance Co.'s new Engineering Research Center during impulse flashover tests. A 62-ft ceiling height accommodates the 2,400,000-v impulse generator shown at rear. In left foreground is the 60-cycle test transformer. Facilities at the center are being made available to utilities, engineering colleges and other manufacturers serving the industry, the announcement states

THIRTY DAYS after it acquired this new plant at Belmont, Calif., Delta Star had put it into production, without interruption of deliveries. Designed for high-volume, continuous-flow production, the plant features an overhead mechanized conveyor line some 500 ft long for metal preparation, painting and baking

LOOKING OVER the new facilities are James W. Mahoney, Western vice president, H. K. Porter, and Joseph Paquin, general manager of Delta-Star Division

SOMETHING NEW HAS BEEN ADDED

DURO FITTINGS ROUND OUT STEEL CITY'S PRODUCT LINE

DURO and STEEL CITY PRODUCTS . . . The complete electrical line . . . Now available from one dependable source!

STEEL CITY ELECTRIC COMPANY PITTSBURGH 33, PA.
Subsidiary of American Marietta Company

For phone number of closest representative see advertising index in back of book.

NEW OUTDOOR lab for high-voltage testing has been built by Ohio Brass at Barberton. Here a tripod insulator stack flashes over on a 60-cycle test, at well over a million volts line to ground. The outdoor facility, next to the indoor lab, will lead eventually to development of all-weather, high-voltage test programs, the company has announced

► **Dr. Lamar P. Bupp** of the Hanford atomic products operation at Richland has been named manager of General Electric's Vallecitos atomic laboratory at Pleasanton, Calif. He fills the post vacated by retirement of **Ralph D. Bennett** last January. **Dr. W. Kelly Woods**, who has been serving as acting manager at Vallecitos, has accepted a position as manager-programming for the Hanford laboratories.

Bupp

► **Floyd E. vonOhlen** has been appointed Western special representative for Electromotive Division of General Motors with headquarters in San Francisco. He succeeds **Corliss A. Bercaw**, who retired following 16 years with the company. Bercaw previously had served Westinghouse and Baldwin Locomotive Works. VonOhlen has been with Electro-Motive since 1942 and was transferred to San Francisco in 1960.

vonOhlen

► **J. R. Wolcott** was named manager of the new Nuclear Electronic Products Section, General Electric's APED, and **Vaughn D. Nixon** will succeed him as manager of manufacturing. Wolcott had been serving as acting manager of the section in addition to other duties. Nixon formerly was manager of the project operations section, which has been discontinued as a separate organizational function. Personnel, facilities and responsibility for project management and project planning and administration have been incorporated into the marketing section, headed by **J. E. Maider.** Proposition planning and estimating has been assigned to engineering.

► Election of **Gerald L. Phillippe** as president and **Cramer W. LaPierre** as executive vice president of General Electric Co. was announced Aug. 1. Phillippe had been comptroller and principal financial officer of the company since 1953. LaPierre was vice president and group executive in charge of the company's Electronic and Flight Systems Group. In making the announcement, Ralph J. Cordiner, chairman of the board and chief executive officer, who had been acting as president since early this year, said that all operating components of the company will continue to report directly to him through the five group executives. Services components will report to Phillippe.

LaPierre's post as vice president, electronic and flight systems group, was filled by **J. S. Parker.** He was moved up from relations vice president. A native of Palo Alto, Calif., his first assignment with G-E in 1950 was at Richland, Wash.

► Southern States Equipment Corp. has changed its name to **Southern States Inc.** The firm has been "Southern States" to the public for some time, it was pointed out.

► **Charles J. Dutcher** has been appointed Sunbeam Lighting Co. representative in the State of Washington. His headquarters will be at 444 Dexter Horton Bldg., Seattle 4.

A Plants Offered In Standard Line

A standard line of large atomic power plants will be offered by General Electric Co. According to the announcement, these plants are expected to be competitive with conventional plants in areas where fuel costs are relatively high.

The line includes plants from 100,000 to 500,000 kw. Prices will vary according to local conditions, the company said, but it will make firm quotations on such items as capital costs and cost of the first two loadings of uranium fuel. Capital costs probably will range between $165 and $200 a kilowatt, the company stated.

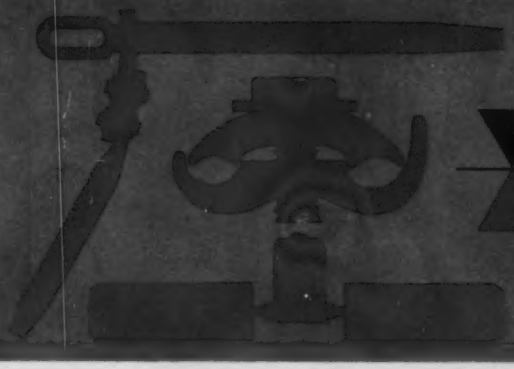
► **Leonard C. Koke** has been named manager—Vallecitos experimental superheat reactor project for G-E's atomic power equipment department at San Jose. He will continue in his capacity as manager—RWE project, responsible for the 15,000-kw APED designed reactor nearing completion at Kahl, West Germany.

Koke

► Line Material has announced new assignments in its field sales organizations. **Harold Dobaj,** who has been in Colorado, was transferred to Portland, and **Chester J. Carter,** former fiber products engineer in the Mountain States Region, will replace him as field engineer in the Denver area. **Andrew C. Genor** Jr. will replace Carter at Spokane. Harold T. Brazil will go to Seattle to take Genor's former post as lighting products engineer in the Mountain States Region.

► **W. E. Kerr,** president of **Pennsylvania Transformer** Division, has accepted chairmanship of the company's Pennsylvania-Lectro Management Group, which includes the Transformer Division, the J. G. Dickson, Lectromelt Furnace and Pittsburgh Lectrodryer divisions.

► **Allis-Chalmers** has appointed two new Western distributors for its Industries Group products. They are **General Pump** Co., 118 S. Nevada Ave., Colorado Springs, and the **Reed Electric Sales & Supply** Co., 2539 N. W. Vaughn St., Portland.



ALCOA ALUMINUM
ACCESSORIES ROUNDUP

Joint Compounds

D. W. Sawyer
Research Engineer
Alcoa Research Laboratories
New Kensington, Pa.

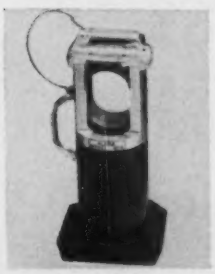
Electrical joint compounds for aluminum-to-aluminum or aluminum-to-copper conductor connections have a dual function. First, they must assist in forming a low resistance joint; they must also exclude corrosion-creating elements which would tend to deteriorate the connection. To effectively exclude moisture, the compound must have properties including long life, stability, wide temperature range without melting or excessive stiffness, resistance to erosion by weather exposure, and workability for ease of application.

To test resistance to erosion by water impingement, Alcoa developed a laboratory apparatus which releases a stream of water drops from a height of 12 inches above test panels placed at 45° angles to the impinging drops. These test panels are coated with a $\frac{1}{64}$-inch film of the compounds being tested. The streams run at a controlled rate of 260 drops per minute. Eight sets of duplicate samples may be tested simultaneously.

This test reveals spectacular differences in the effectiveness of compounds. Some become eroded almost immediately and are washed away in 15 minutes to 24 hours. Others are almost unaffected. Alcoa has found that compounds which will survive this test for an 18-day exposure are satisfactory—and field experience has shown this to be a reliable indication of good performance.

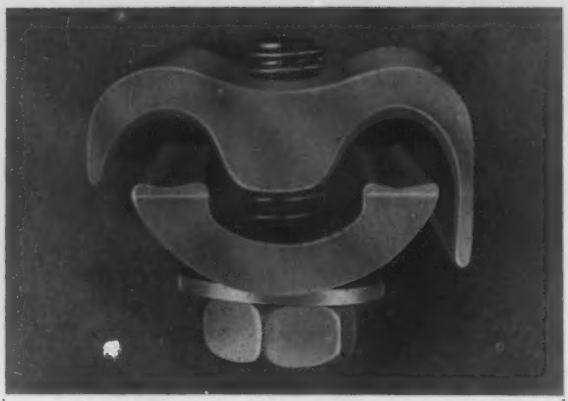
Currently under test and development is a new Alcoa compound which has met and exceeded all requirements.

Compact power... concentrated power



That's the quick way to sum up the characteristics of the Model 60A Hydraulic Compressor. The Alcoa 60A delivers 60 tons of thrust for the application of compression accessories for line construction or maintenance work with any commercial conductors up to and including the 1,590 MCM size. It operates at 10,000 psi and is used with remote pumps that may be hand operated or driven by either electric or gasoline power. For the past six years Alcoa has offered the Model 60A as *the* rugged, fast, convenient portable tool for ground or aerial use. Also, consider the economy of the 60A; most compressors in its price range deliver 40 tons of pressure or less. The Alcoa dies designed for use with this 60-ton compressor are priced modestly so that even greater savings are possible. For complete specifications about this money- and timesaving tool, contact your Alcoa-Rome representative.

(Continued on next page)



Here are just a few of the many groove shapes studied by Alcoa before selecting the most efficient contour for bolted connectors. They typify the thoroughness with which Alcoa approaches every accessory problem.

We've added a new one!

In 1953 Alcoa developed an improved groove contour for bolted connectors intended for use over a range of conductor sizes. Both varied pressure and resistance tests, and heat cycling showed the effectiveness of this groove shape when proper aluminum alloys were chosen for the connector design.

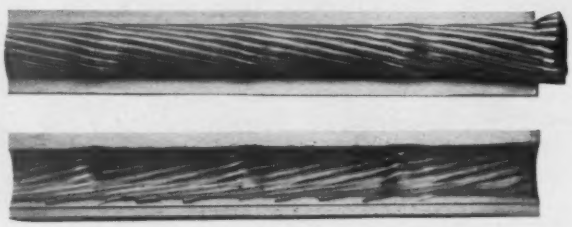
This addition to our widely imitated line of Universal Parallel Groove Clamps is designated Cat. 395.5. It economically connects a range of conductors from #6 to 1/0 in either groove. Like other extruded Alcoa® pg clamps, the 395.5 has a unique "breathing" action which, during temperature changes, provides the flexing spring action needed to assure good conductor contact. Extruded in a strong heat-treated aluminum alloy, the new 395.5 clamp is compact, easily taped, and can be applied without being taken apart. Get the full story about this new clamp, or more details on others in the 390 series—including those prefilled with Alcoa joint compound and packed six to a box—by contacting your usual source of Alcoa materials.

Continuous compression is best

Alcoa has always taken the position that facts should speak for themselves. And the facts, based on years of testing joining methods for conductors of all sizes and types, point to this conclusion: Longer die bites and continuous compression offer more *consistently reliable* joints, under service conditions of maximum severity, than does the skip-bite method. By reliability we mean electrical resistance lower than an equivalent length of the conductor, mechanical strength in excess of 95% of the conductor rated strengths, and the ability to *last*.

The use of longer dies—with each bite overlapping—not only gives better performance with ACSR, but also with special conductors.

Of course, tools of higher capacity are needed for the continuous-compression method. So Alcoa makes tools larger, more rugged, to insure better performance.



Cutaway view shows strand-imbedment on inner surface of sleeve, following use of continuous-compression method. All evidence points to the superiority of this technique over skip-bite.

Alcoa compression accessories are, in many cases, more conservative in design than those of other suppliers, since *reliability* is still considered to be the basic consideration. The continuous-compression method is also strongly supported by these additional advantages: Inspection for proper application is easy, even from a distance; sleeves are straighter after compression; and there is no need to match die width to skip-bite markings. And the smooth surface provided by this method of compression is especially important in the design of component parts for Extra High Voltage applications.

Alcoa sells the tools, the dies, and the compression accessories, carefully designed to make *consistently reliable* connections using the proved continuous-compression method. The Rome-Alcoa salesman will be glad to provide details.

Summing up:

Water erosion adversely affects many joint compounds—but not those made by Alcoa. A new compound, soon to be released, performs well on this and all other counts.

More useful power per dollar is what you get with Alcoa's Model 60A compressor.

New Cat. 395.5 pg clamp is now available for conductors ranging from #6 to 1/0.

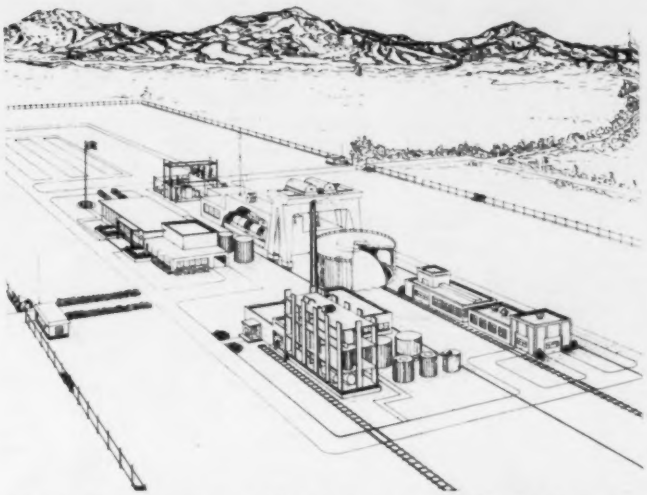
Take a big bite, and do it continuously, for consistently reliable joints.

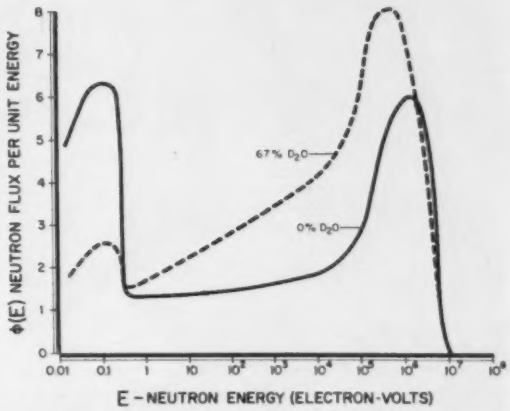
Your nearby Alcoa-Rome salesman is eager to supply additional information on any or all of these items. Why not call him today? For the name and address of our nearest representative, write to Rome Cable Division of Alcoa, Dept. ACR-7, Rome, N. Y.

ALCOA
ROME CABLE
DIVISION

PRODUCT NEWS

New designs and applications





The sketch at left gives an idea of the spectral shift control reactor plant arrangement, showing the small containment sphere and external shielding. The curve at right shows the shift in neutron energy as a function of the concentration of heavy water

Spectral Shift Control Reactor

Babcock & Wilcox Co.

Few of the prophets in the "dark" nuclear age of three years ago would have predicted that in 1961, utilities could generate competitive atomic power in this country. Nonetheless, a version of the pressurized water reactor which, based on West Coast utility accounting practice, promises to generate power at a cost of 5.5 to 6.0 mills per kwh, has been developed by the Babcock & Wilcox Co.

B&W officials report that the economies made possible by their reactor are based on increased core life and more efficient fuel consumption. The result is a competitive steam plant which has stimulated utilities in this country and abroad to study the SSCR.

The advanced PWR, the spectral shift control reactor (SSCR), was first developed by B&W in 1956 at the company's Lynchburg, Va., facilities. The reactor is different in that it uses mixed light and heavy water as the moderator-coolant.

The feasibility of the SSCR control principle was demonstrated experimentally under a $1,223,500 contract with the Atomic Energy Commission. This contract followed several years of work by B&W on its own. Recently the company received a second contract from the AEC to continue its promising work on this reactor.

The origin of the name, spectral shift control reactor, comes from nuclear technology. Spectral, or neutron energy, shift is accomplished by changing the ratio of heavy-to-light water during the operation of the reactor. In the process, excess reactivity, i.e., fuel for extended core life, is economically controlled to yield maximum power with minimum fuel consumption.

Since this reactor will be operated with most of the control rods withdrawn at full power (the neutron flux pattern is fairly flat—peak to average approximately 2 to 1), more heat can be extracted from the reactor. This feature of allowing all fuel rods to work at heat fluxes nearly equal to the average flux is one of the most valuable features of spectral shift. No other ordinary water system can safely achieve a peak-to-average power of 2 to 1.

In areas such as the West Coast where frequent static weather conditions exist and population densities are high, nuclear installations must meet the highest safety criteria. As a result of the SSCR design, several safety features have been engineered in the reactor that are not available in the ordinary PWR. For example, the liquid moderator-coolant required by the primary loop is held to a minimum, without sacrificing required radiation containment for every credible situation. The smaller primary loop results in a smaller containment sphere and external shield. Conceivably, the SSCR could be built underground. Thus, the triple safety containment planned for the SSCR meets the criteria of the toughest site conditions.

A 400-mw SSCR will cost less than $180/kw to construct, company officials state. This includes the heavy water inventory. Initial fuel costs of slightly under 2.5 mills indicate that no difficulty is foreseen in staying substantially under the 6.0 mill "upper limit."

As remaining conservatisms of design give way to knowledge from extended operation, power ratings will climb and costs decrease, as is often the case for second and third units of a series, the company said.

Circle No. 1

Spacer

Aluminum Co. of America

Dumbell-like devices called "bundled conductor spacers" have been developed by Alcoa Research Laboratories for installation on the Project EHV prototype transmission system located near Pittsfield, Mass.

The bundled conductors on which these spacers were applied were energized briefly at 720,000 v in December and have been operating regularly at 460,000 to 500,000 v since January.

Circle No. 2

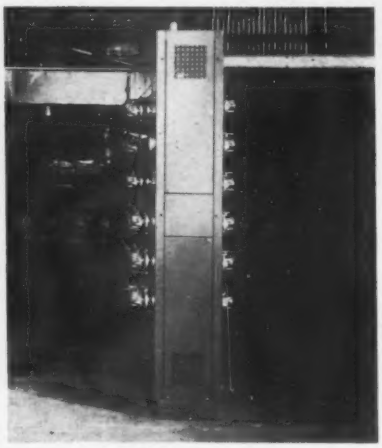
Three-Phase Protector

Emerson Electric Mfg. Co.

A new static transistorized three-phase protecting device that operates from voltage signals and protects personnel, motors and machinery against three-phase voltage unbalance, phase failure or phase reversal has been announced by this company's Industrial Electronic Division.

Designated PhaseGuard, the new device can be used on either delta or wye three- and four-wire systems. According to Emerson's engineers, previous operation of complete phase protecting devices was dependent upon phase current and phase voltage amplitude. PhaseGuard, however, continuously monitors the three-phase voltage circuits for both magnitude and phase relationship. When an unbalanced voltage condition exists the transistorized electronic circuit triggers a circuit relay.

Circle No. 3



Metering Switchboard

I-T-E Circuit Breaker Co.

A new design, free standing metering switchboard, accommodating nearly twice as many meters in half the space required for a comparable quantity of wall mounted units, and reducing installation costs and time, has been announced by this company's Walker Division.

Circle No. 4

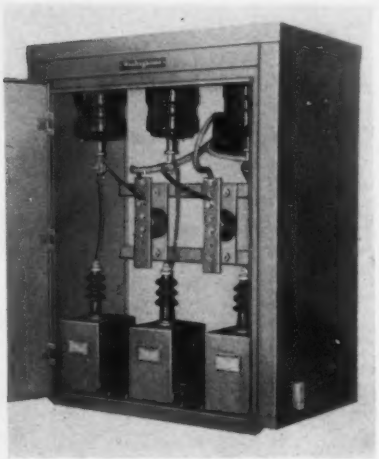
Meter Socket

Anchor Mfg. Co.

A new 200-amp ringless meter socket is now being manufactured by Anchor Mfg. Co. This socket is available with a new type of lever operated by-pass in 4-, 5-, 6- or 7-jaw arrangements and has terminals for 250 mcm maximum copper or aluminum cables and an enclosure of ample size for either top or bottom feed. After removal of the cover, a wire bail is exposed which when pulled forward by-passes the meter.

The wire bail lever is arranged so as to make it impossible to replace the cover without moving the lever to withdraw the bypass.

Circle No. 5



Surge Protector

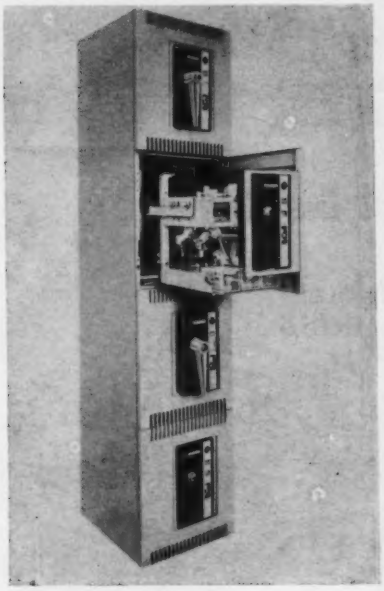
Westinghouse Electric Corp.

Protection for rotating a-c machines against line surges caused by switching, faults or lighting using a factory preassembled protection device (Surgepak) has been announced by Westinghouse Electric Corp.

The protective units, custom designed for each application, are attached and wired into the circuit of the rotating a-c machine by either the machine manufacturer or the user. Ratings are available for system voltages from 2,400 to 13,800 v.

The basic components consist of lightning arresters with special low discharge and sparkover characteristics, in voltage ratings from 3 to 15 kv; and surge capacitors that eliminate the possibility of turn-to-turn flashover by decreasing the slope of the wave fronts.

Circle No. 6



Switchgear

Federal Pacific Electric Co.

This new FP line of assembled switchgear is said to be designed for safety and ease of maintenance. Individual breakers may be completely withdrawn from the enclosure and tilted to permit close inspection of all parts. The manufacturer states this line is the first to permit four-high stacking of 2,000-amp breakers or 50,000-amp interrupting capacity breakers in a 90-in. cell.

Circle No. 7

Single-Lamp Fixture

Sunbeam Lighting Co.

A new single-lamp Visionaire No. 7401 is now available from Sunbeam. This fully enclosed all-plastic shielded lighting fixture forms a matching complement to the two-lamp and four-lamp Starama series. A complete and unified lighting pattern can now be achieved from narrow corridors to expansive areas. The architect, engineer and building owner can be assured of having harmonious lighting throughout a building with fixtures of the same general style and illuminating characteristics.

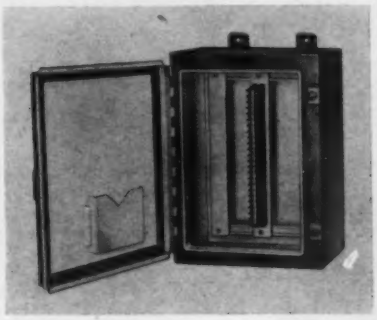
Circle No. 8

High-Flash Insulating Oil

Shell Oil Co.

A higher minimum flash point for Diala Oil AX, an electrical insulating oil for large transformers and high output electrical equipment, has been announced by Shell Oil. The improved product has minimum flash point specifications of 295 F (Cleveland open-cup method), with typical flash point test values ranging from 300 to 305 F. The high-flash Diala Oil AX makes it practicable for equipment manufacturers to designate power equipment for operation safely and continuously at substantially higher outputs and temperatures than heretofore.

Circle No. 9



NEMA Type 12 Enclosures

Huenefeld Co.

New NEMA type 12 terminal enclosures, providing positive protection against dirt, dust, oil and water, have been introduced by this company along with an offering of new JIC terminal kits for use in JIC wiring boxes. The new NEMA 12 terminal enclosures are constructed with continuous weld seams and employ horizontal brackets with slots and spring locking nuts, permitting convenient positioning and spacing of the vertical straps for easy wiring of the terminal blocks.

Circle No. 10

Service-Entrance Cable

General Electric Co.

A new service-entrance cable with Vulkene insulation, said to double the life expectancy of the cable, has been announced by General Electric's wire and cable department. The insulation used is the company's recent development, a thermosetting, rubberlike insulation of chemically cross-linked polyethylene that combines the electrical and moisture-resistant properties of polyethylene with physical and heat-resistant properties superior to those of rubber, according to the manufacturer.

Circle No. 11

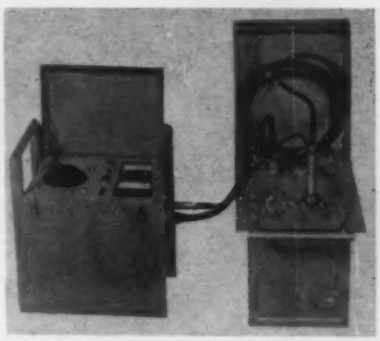
Earth Borer

Holan Corp.

Holan is offering an optional earth borer that converts the Holan HV elbow into an all-purpose utility tool.

A specially designed attachment near the end of the lower boom of the elbow accommodates the Holan 5400 earth borer, enabling the unit to bore holes as far as 13½ ft from either side of the truck body. Because the elbow rotates 360° continuously in either direction, the digger and derrick can be operated behind and on either side of the truck.

Circle No. 12



Underground Cable Tester

Duncan Electric Co. Inc.

A new line of equipment for quicker and safer underground cable testing and fault locating by power company crews has been designed around a high voltage portable power supply unit manufactured by this company's Davenport Manufacturing Division.

The testing methods made possible by this type of equipment not only reduce the hazards of working around energized cables, but substantially cut the time required for most fault-locating jobs.

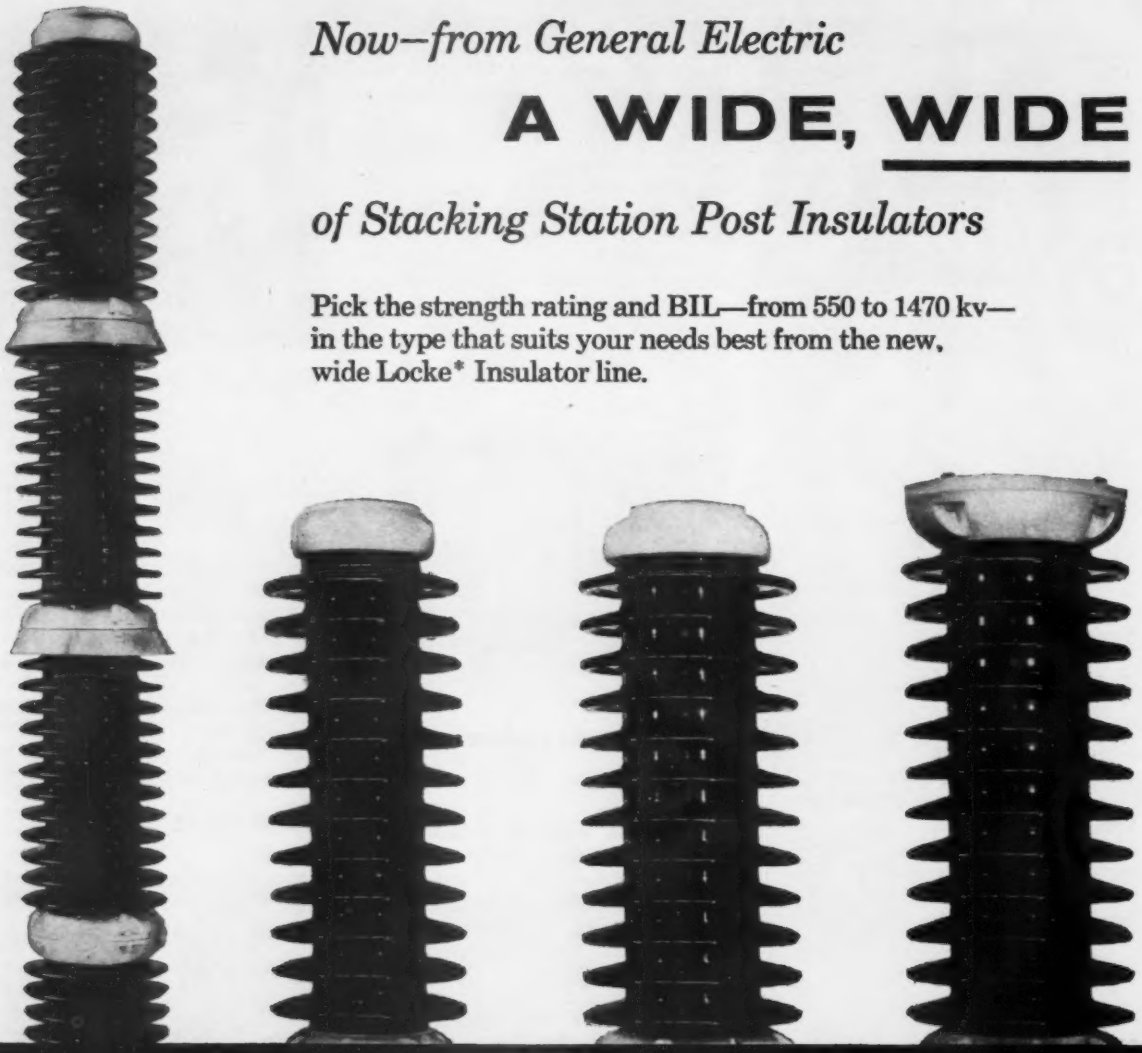
Circle No. 13

Now—from General Electric

A WIDE, WIDE

of Stacking Station Post Insulators

Pick the strength rating and BIL—from 550 to 1470 kv—in the type that suits your needs best from the new, wide Locke* Insulator line.

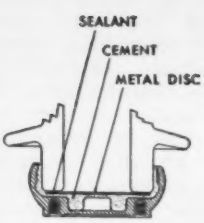


Type A

Made to General Electric's exacting product standards and proved under rigid mechanical and electrical strength test procedures. Available in standard, high and extra-high strength ratings.

Type B

Completely interchangeable, each unit can be used anywhere in the stack. Use 2, 3, or 4 units to get the BIL you require. The adapters for top and bottom of stacks allow quick, easy installation on switches . . . as bus supports . . . anywhere. Type B units used with adapters meet standard stack heights. Available in standard, high and extra-high strength ratings.

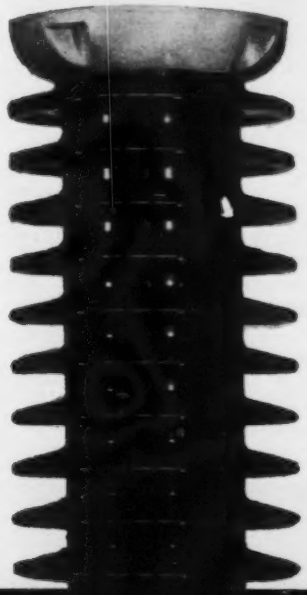


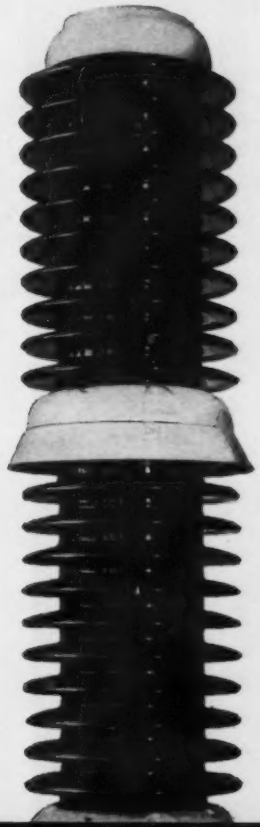
Featured on all Locke* Stacking Station Post Insulators—the unique METAL-POLYMER SEAL—proven completely effective after a 6-year field test!

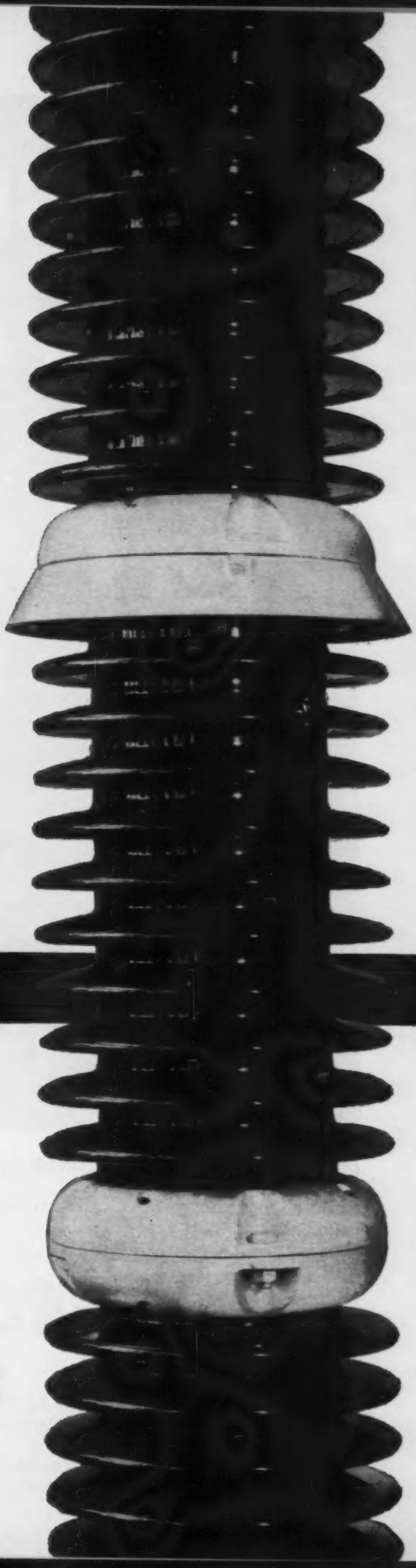
Illustration shows insulator taken out of service after six years and returned for laboratory tests. Removal of cap and cement revealed no deterioration of metal disc. Perfectly sealed system for forcing gas into porcelain cavity was set up. Even under 10 p.s.i. pressure, "sniff" tests were negative, proving seal completely effective.

SELECTION

ADAPTER PLATE







See your LOCKE Insulator representative for complete technical advantages of this new, wide line of stacking station post insulators. Or, write directly to: Insulator Department, General Electric Co., P. O. Box 57, Baltimore 3, Maryland.

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Satisfy all your requirements . . . whether for extra heavy duty Type W power cable or light, flexible Type SJ cord.

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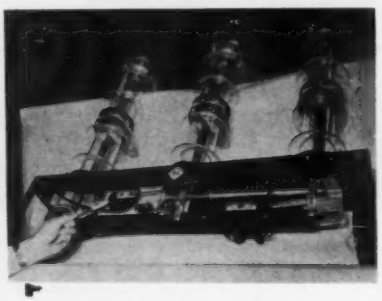
Flush-Mounted Starters

General Electric Co.

Flush-mounted magnetic starters for contractor installations have been added to General Electric's 100 line of motor controls.

Available for cavity mounting in machinery or for mounting in plaster walls, the new forms are rated up to 600 v, 60 to 25 cycles in NEMA sizes 0, 1 and 2.

Circle No. 14



Motorized Capacitor Switch

Allis-Chalmers Mfg. Co.

Availability of a motorized operator for its type VSC, three-phase, 15-kv, 300-amp vacuum capacitor switch has been announced by Allis-Chalmers. The new motorized operator may be powered from a source of 115 v a-c, 125 v d-c, 230 v a-c or 250 v d-c. Its motor draws between 0.2 and 0.8 amp.

The motorized operator is said to require less control power than the optional solenoid operator initially offered on this switch.

Circle No. 15

MANUFACTURERS' LITERATURE

For fast action in securing the manufacturers' literature listed below and more information on new products described in the preceding pages, use the coupon below. Circle the items wanted and mail to Electrical West

AERIAL CABLE—Sherman & Reilly has issued catalog supplement 611-A covering a new method for installation of spacer-type aerial cable. Called the continuous stringing system, the new concept enables uninterrupted stringing from start to finish, the manufacturer states. The system includes a messenger traveling block and messenger bracket that permits the blocks and conductors to pass the poles without assistance. The bulletin has complete specifications and pictures of an actual installation along with step-by-step explanation. *Circle No. 16.*

SELECTOR DISC—Westinghouse is offering a 7-in. selector disc that can be used to identify six basic types of circuit breakers. By rotating and matching top and bottom sections, the customer can determine physical and electrical characteristics in various types and sizes. He can read depth, width, height and number of poles; maximum amperage and voltage and interrupting ratings for varying a-c and d-c voltages. *Circle No. 17.*

WIRE—Western Insulated Wire Co. gives data on Bronco multiconductor electrical cables used in control circuits in a new 30-page catalog. *Circle No. 18.*

BREAKERS—Advantages of five-cycle type OZ distribution oil circuit breakers for 14.4- and 23-kv service are discussed in a new Allis-Chalmers bulletin. The manufacturer states that construction features normally found only in transmission breakers are pegged in illustrations. The bulletin also carries a reference table of general dimensions and ratings. *Circle No. 19.*

SAFETY GUARDS—Its new line of plastic safety guards for guy lines is described by the Electrical Products Division of Fanner Mfg. Co. in Catalog Section SG-1, 2. According to the manufacturer, these guards may be used with any standard type of dead-ending clamp. Drawings, illustrating typical methods of attachment, are included. *Circle No. 20.*

OVERHEAD—For electrical utility engineering and purchasing departments, Rome Cable Division has published Advanced Design Tubular Accessories for Overhead Conductors. The new booklet, which revises and expands previous available material, gives a comprehensive listing of Alcoa tubular compression accessories for several types and sizes of conductors. Featured are suggested installation methods, explanatory sketches and cables listing dimensions, weight and filler compound requirements. *Circle No. 21.*

POWER FUSES—Application and selection of high-voltage power fuses are discussed in a 16-page booklet offered by Westinghouse. Discussed are refill power fuses, drop-out power fuses and current limiting power fuses. The booklet also contains information on the interrupting ability, continuous current ratings and melting characteristics. For a copy of this booklet 36-660, *circle No. 22*

CONTACTORS—NEMA size 3 and 4 magnetic contractors and starters are described in General Electric's bulletin GEA-7326. Pictures and diagrams show space savings made possible by use of the new forms. *Circle No. 23.*

STRINGING EQUIPMENT—A new price list for general tension stringing equipment has been issued by Petersen Engineering Co., in catalog TSE-1. *Circle No. 24.*

ELECTRICAL WEST *Not good*
255 California St., San Francisco 11, Calif. *after November 1*

Please send me, without obligation, the new product information or catalogs.

If described in Product News, circle item number

1	2	3	4	5	6	7	8	9	10	11	12
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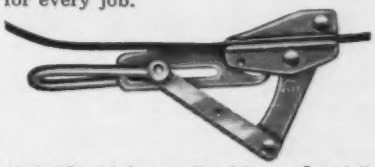
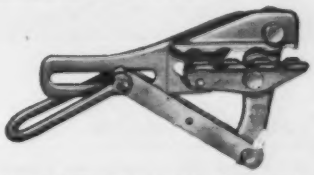
60 DIFFERENT KLEIN GRIPS MEET EVERY UTILITY NEED

If you want a strong, nonslipping grip for use on any type of conductor . . . if you need a pattern specially designed for hot line work . . . consult your Klein Catalog. Klein grips are designed for solid and stranded cable, for messenger guy strand and wire rope, and for weatherproof wire.

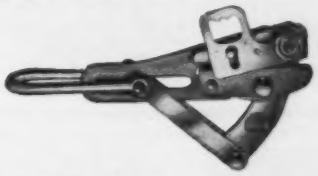
Write for the Klein Grip Selector to make sure you have the proper grip for every job.



1656-40B with bronze-lined jaws. Specially designed for bare A.C.S.R. aluminum and stranded copper cable.
Opening from .50 to .74 inch.



Machined jaws allow snaking insulated conductors, eliminating slippage and preventing conductor damage. Insulation does not have to be stripped from conductor.
1659-40—openings from .49 to .80 inch.



This hot line grip may be placed on wire with stick. Safety latch has three positions and closes automatically when stick is removed. Cannot fall off wire. Can be used for hot or dead work.
1628-5BH—openings from .198 to .522 inch.

FREE GRIP SELECTOR
To utility companies, the grip selector is available without charge. It shows the proper Klein grip for any type of wire and gives full information for servicing.

Foreign Distributor:
International Standard Electric Corp., New York

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Most complete line with addition of 2 new sizes to oldest established standards in the industry.

The saddle or pipe support can be turned 360°, permitting pipe to run parallel or at right angle.

Excellent for confined areas—No drilling—no use of straps.

Made of the highest grade malleable iron, with case hardened set screw—all cadmium plated. For Aluminum, write for details.

For hanging ½" thru 2½" pipe or conduit to steel beams ⅜" thick.

FULLMAN MANUFACTURING CO.
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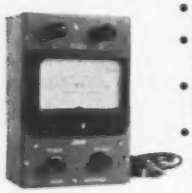
Compact-Precise

THE SANWA TRANSISTORIZED MEGOHM METER

now available for the first time from Japan,
⅓ THE SIZE, ⅓ THE PRICE
of comparable instruments.

Check these features of this unique megger tester...



- Transistorized, power from standard batteries.
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- Available in seven sizes... from 100V-200MΩ to 500 & 1000V, 1000 & 2000MΩ.
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Proposed Western Projects

Alaska

College, Alaska, University of Alaska, heating plant, $2,707,500.

Palmer, Independent School Dist., $1,000,000.

Rocky Mountain

Boise, Idaho, Bank Realty Co., office, $5,000,000. In care of Bank of Idaho, lessee.

Boise, Safety Stores Inc. and Skaggs Drug Co., supermarket and drug center. Plans by Grider & La Marche; D. S. Wisdom, electrical engineer; Barton, Stoddard & Milhollin, structural engineers.

Great Falls, Mont., School Dist. No. 1, $2,560,694. Wenzel & Co., structural engineers; plans by Page & Werner.

Woods Cross, Utah, Phillips Petroleum Co., alkylation plant, $1,500,000.

Casper, Wyo., School Board, school, $1,750,000. Plans by Architectural Guild.

Pacific Northwest

Port Mellon, Canadian Forest Products Ltd., mill, $12 million. Sandwell & Co. Ltd., Vancouver, consulting engineers.

Vancouver, Thomas J. Campbell, apartment, $2,700,000. Plans by Peter Kaffka.

Vancouver, Vancouver Wharves Ltd., dock, $1,000,000. Swan, Wooster Engineering Co. Ltd., consulting engineers.

West Vancouver, Ivory Towers Ltd., apartment, $4,000,000. In care of Chomick & LeBlond, architects.

Castle Air Force Base, Calif., U. S. Engineers, Sacramento, hospital, $1,780,000. Plans by Stone, Marraccini & Patterson, San Francisco.

Napa, Union High School Dist., junior college bldg., $2,341,000.

Oakland, California-Nevada Methodist Homes Assn., apartment, $6,000,000. In care of John Graham Co., Seattle, architect.

Oakland, City and Alameda County, sports stadium, $12-15 million. Plans by Skidmore, Owing & Merrill, San Francisco; Ammann & Whitney, New York, consulting engineers.

Palo Alto, Alhouse Realty Inc., office, $1,500,000. In care of A. C. Prentice, architect.

Richmond, John M. Stahl Co., apartment, $5,000,000. Plans by Donald Hardison & Associates.

Salinas, James Walker, motel, $1,000,000. In care of Irvin W. Goldstine, Menlo Park, architect; Ira S. Kessy, Oakland, consulting engineer.

Cottage Grove, Ore., School Dist. No. 45J3, school, $1,171,280. Plans by Wilmsen, Endicott & Unthank, Eugene; Stephen H. Ford, engineer.

Cheney, Wash., Eastern Washington College of Education, dormitory, plans by Culler, Gale & Martell; commons bldg., plans by Funk, Murray & Johnson; $2,272,500.

Bellevue, Overlake Park Inc., shopping center, $11 million. Plans by John Graham & Co., Seattle.

Bellevue, H. R. Watchie & Associates, shopping center, $20 million. Plans by Welton Becket & Associates, Los Angeles.

Parkland, Pacific Lutheran University, dormitory, plans by Lea, Pearson & Richards, Tacoma; dining hall, plans by Johnston-Austin, Tacoma; $1,100,000.

Spokane, H. Halvorson Inc., office, $1,500,000.

Tacoma, International Glass Industries Ltd., plant, $1,500,000.

Tacoma, Jack McConaghy, retirement home, $1,345,000.

Pacific Southwest

Artesia, Calif., Excelsior High School Dist., schools No. 5 and 6, $4,000,000. Plans by Kistner, Wright & Wright, Los Angeles.

Beverly Hills, Robert Felixon, office, $5,000,000. Plans by Sidney Eisenhtaat.

Los Angeles, Loyola University, additions, $1,750,000; science bldg., $1,500,000. Plans, Albert C. Martin.

Los Angeles, Theodore H. Bentley, Ray A. Watt and Bill S. Hunter, apartment project, $16 million. In care of Paul R. Williams & Les Scherer, architects.

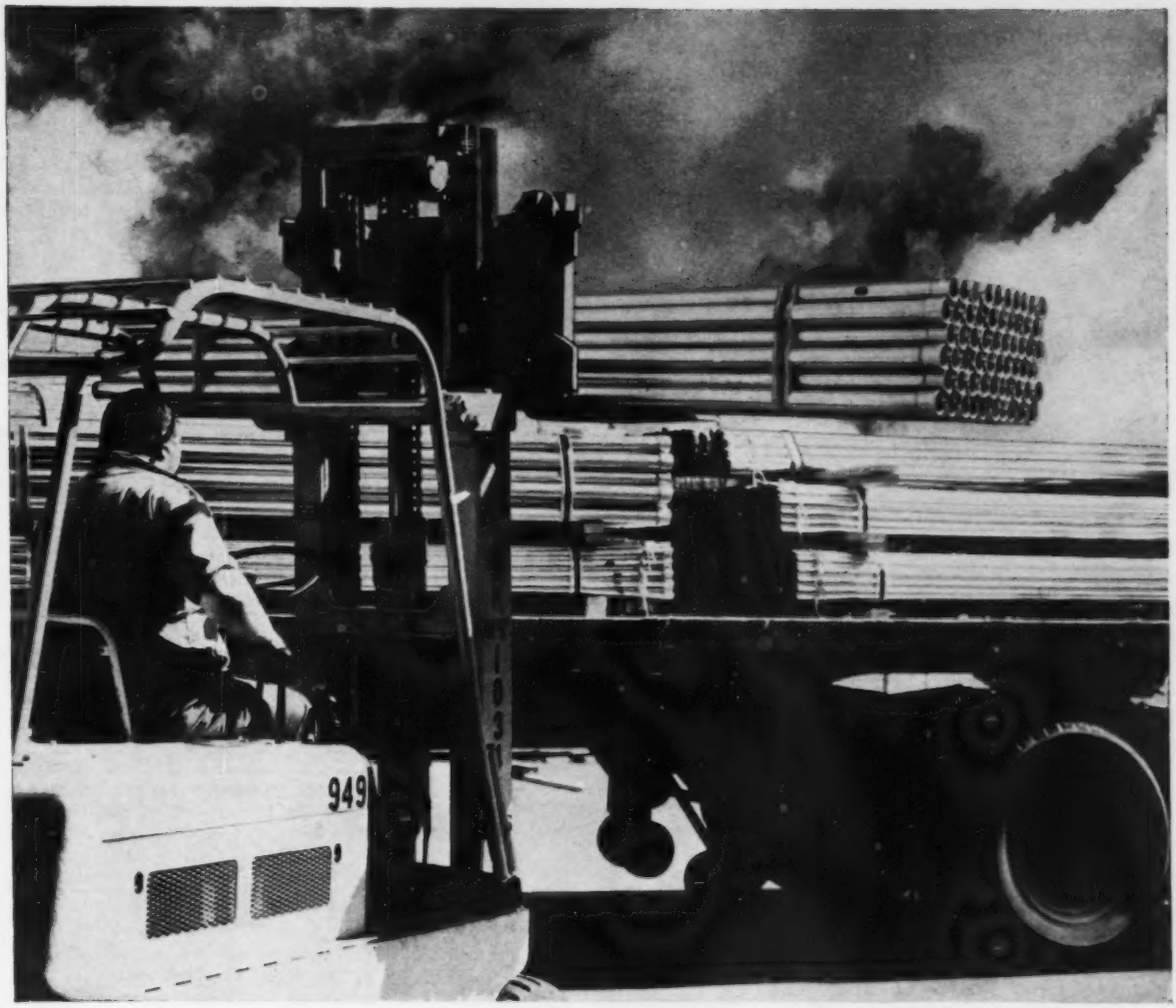
Los Angeles, California Lutheran Hospital, addition, $3,000,000. Plans by Walker Kalionzes & Klingerman.

Pomona, City, police and fire headquarters, $1,500,000. Plans by Welton Becket & Associates, Los Angeles; B. H. Anderson, associate architect.

Riverside, University of California, residence halls, $4,100,000. Plans by George Vernon Russell & Associates, Los Angeles.

San Diego, Harbor Commission, terminal bldg., $1,500,000.

San Diego, Dass Construction Co., residences, $1,029,771.



"Just the way they pack it saves me 3% of the cost of the conduit."

On the job site. That's where Rome's quick-stacking strapped bundles of EMT and rigid steel conduit save you time and money.

How much? One contractor* reports that this package was worth 3% of the cost of the conduit to him in labor saving.

Why? Because it permitted machine off-loading and spotting of rigid conduit by size at the job site.

Why they're faster: With Rome's strapped bundles, one of your men with a fork lift or crane can unload and stack a 20-ton truckload in just 30 to 40 minutes.

Compare this with the man-hours eaten up when you unload a truck or trailer of small bundles of EMT or rigid. There's quite a difference. And that applies to big, shipped-by-sea pallets, too, where you have to break big bundles down into hundreds of little ones.

Not with Rome's strapped bundles. Each one contains a uniform quantity of smaller bundles. That makes for easy handling—where it counts—on the job site.

*Name furnished on request.

Other savings: Handling is one way you save. You also run less risk of damage, since the securely strapped bundle *protects* conduit on its way to you and in storage.

Storage is very efficient, since the rectangular shape of each bundle makes stacking easy, neat and unusually compact.

And you can *inventory* quickly. Bundles are uniform, so counting goes very fast.

Why not get all these advantages next time you order EMT or rigid steel conduit? Just specify Rome—in quick-stacking bundles. Contact your Rome-Alcoa representative for more information. Or write to Rome Cable Division of Alcoa, Dept. 4-91, Torrance, Calif.

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For phone number of closest representative see advertising index in back of book.

6135

Copper-free aluminum construction gives Killark fittings bonus life

Killark electrical fittings and fixtures remain permanently rust-proof in weather-exposed locations, and will never stain building exteriors. They also provide better resistance to various types of corrosion, and can be used in many specialized applications. Painting and similar protective measures are not required. The Killark line includes more than 7500 sizes and types of fittings and fixtures. They are stocked for immediate delivery by your local distributor, or in Killark warehouses in 18 cities throughout the United States and Canada.

***KILLARK ENTRANCE ELBOWS**

Available in 13 sizes from ½" through 6", and in a variety of styles. Flanged cover overlaps gasket and edge of fitting, making elbows waterproof. Service ells with weep holes and with grounding hubs for grounding rods available.

***KILLARK SERVICE ENTRANCE HEAD**

30 sizes, ½" to 6", threaded or slip-on. Special reversible feature on some sizes allows use at end of horizontal conduit or top of vertical conduit. Includes composition insulator with required number of holes. Designed for easier handling of stiff, heavy cable.

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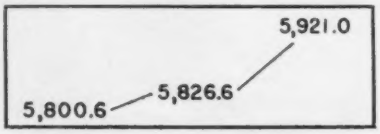
In Canada: Killark Electric of Canada, Ltd., 421 Islington Ave. South, Toronto 18, Ont.

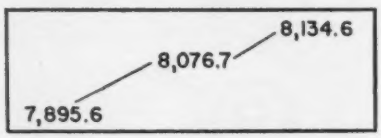
WESTERN

Economy at a Glance

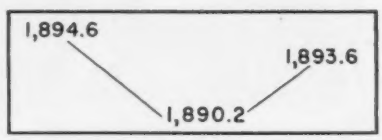
Year Ago	Month Ago	Latest Month



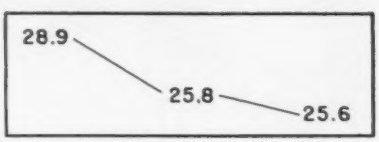
PERSONAL INCOME in millions—seasonally adjusted as of August 15 (An index of consumer spending potential)



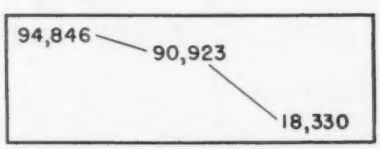
NONFARM EMPLOYMENT in thousands (Index of industrial, commercial activity)



MANUFACTURING EMPLOYMENT in thousands (A measure of manufacturing activity)



HOUSING STARTS in thousands of units (Index of new residential customers)



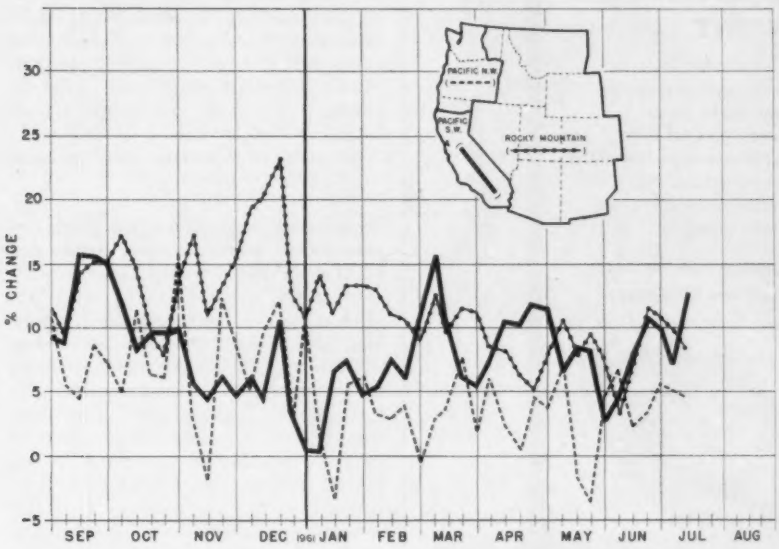
INDUSTRIAL BUILDING CONTRACTS in thousands of dollars (A rough index to the dollars of electrical contracting business six months to a year ahead)

► **The unemployment rate** is the number of jobless persons expressed as a per cent of the total labor force. The U. S. counts as unemployed anyone 14 and over who is out of work and would like a job—even if he is doing little toward finding one. Many other countries count only those receiving unemployment compensation. These differences in counting methods make international comparisons quite hazardous.

BUSINESS TRENDS & INDICATORS

Output Comparisons

Year-to-Year Kwh Output Changes. Per Cent Change Over Same Week. One Year Ago for Region as Indicated in Keyed Map



Manufacturers Forecast Continue to Rise

Capital goods manufacturers cooperating in the quarterly McGraw-Hill Machinery Forecast now predict their new orders will continue to rise steadily through the remainder of this year and on into 1962. The current forecast of 188 (1950=100) for the second quarter of next year is an all-time high for machinery orders. The highest previous quarterly average was 180, attained only twice in the past 12 years.

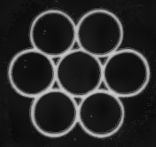
Manufacturers in all six nonelectrical machinery categories included in this forecast predict gains in new order bookings comparing the second quarter of next year with the like period this year. Makers of metalworking machinery forecast an 11% increase and pump and compressor builders expect a 4% gain.

RELATIVE WHOLESALE PRICES OF ELECTRICAL MATERIAL

	Latest Month	Previous Month	Year Ago
Wire and cable	131.1	128.9	137.5
Watt-hour meters	118.6	118.6	120.9
10-hp motors	136.9	136.9	136.1
225-hp motors	176.8	176.8	229.0
Hydro generators	185.5	185.5	185.5
Steam generators	193.2	193.2	203.5
15-kva transformers	133.0	133.0	133.5
50-kva transformers	131.0	131.0	137.3
500-kva transformers	124.6	124.6	147.1
Dry-type transformers	133.7	133.7	146.0
Switch and fuse panelboards	126.0	126.0	132.4
Circuit breaker panelboards	139.2	139.2	139.1
Indoor oil circuit breakers	182.4	182.4	182.5
Outdoor oil circuit breakers	158.9	158.9	181.3

Source: McGraw-Hill Department of Economics.

DEPENDABLE PROTECTION AT LOW COST



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The strong, tough individual wires which make up ***Crapo*** Galvanized Steel Strand are protected against corrosion by a uniform, tightly-bonded, ductile coating of commercially pure zinc. This heavy, dense coating of zinc, applied by one of the time-proven ***Crapo*** methods, not only seals out rust but further protects the base metal by sacrificing itself through galvanic action. The result: long and dependable performance at low yearly cost.

CHOOSE FROM 3 COATING WEIGHTS

Crapo Galvanized Steel Strand is available in three weights of coating, Class A, B and C. Class B has twice the zinc by weight per square foot of wire surface as Class A; Class C has three times that of "A."

Contact the *Crapo* Galvanized Steel Strand distributor near you for prompt shipments from his stock or from our mill.

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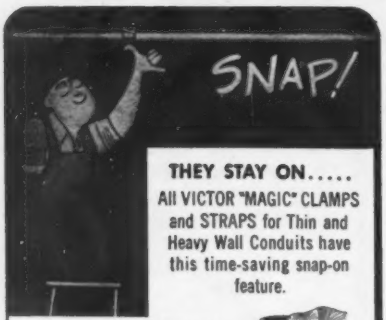
Write for complete information to:
CORROSION REACTION CONSULTANTS
116-2F-Chestnut Street, Phila. 6, Pa.

Ask your distributor



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Don't accept substitutes. The extra slip means extra savings on every job.

- Creamy, non-corrosive. Never greasy or messy.
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Thread lubricant stops binding of aluminum conduit connections!

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LATE NEWS

Continued from page 101

basis of the code discussions at the fall series of IAEI meetings. Western meetings include that of the Northwestern Section at Boise Sept. 11-13 and the Southwestern Section at Long Beach Sept. 18-21. These proposed amendments can still be changed but final comments are to be submitted by Dec. 1 of this year. This will be for the 1962 edition of NECode.

►**Substantially stronger penalty** provisions were written into the California Bid Listing Law and become effective Sept. 15 by AB-2241. It clarifies the ambiguity in the penalty clause and provides that any violation of the listing law is a basis for disciplinary action under the Contractors License Law. The penalty, although reduced from 20% to 10%, is payable to the fund out of which the contract is awarded, thus providing an incentive for the awarding authority to enforce the law.

► **To implement the four-hour moratorium** bidding practice plan, a voluntary one, in southern California a newly formed organization, "Construction Bidding Practices Conference," has named Walter A. Smith Jr. as executive manager and established offices at 1725 Beverly Blvd., Los Angeles. The conference becomes operational on Sept. 11 but a campaign is under way to enlist contractors, subcontractors and suppliers in the voluntary program. The program is supported by many of the trade associations in the construction industry.

► **Robberies by phony building inspectors** in Portland has caused the city of Portland to publicize the identification cards of all real Bureau of Building inspectors in the city newspapers to warn the public not to give entrance to any one claiming to be an inspector unless he can identify himself. The official card carries both the inspector's picture and his signature and thumb print. The phony inspectors have usually victimized elderly persons, gaining entrance by saying they want to "check flickering lights." Other cities may anticipate a similar wave of thefts if a gang of this type moves from town to town. Similar tactics have been used to sell a rewiring job, siding, roofing or painting, even with FHA financing in some cases.

LETTERS

Credit Due Architects

To the Editor:

A copy of your April issue of ELECTRICAL WEST crossed my desk today. A photograph of the recently remodeled second floor of the J. Magnin, Stockton and O'Farrell store in San Francisco appears on the cover.

The cover, as well as the article on p 86 entitled "A Luminous Solution for a Low Ceiling in a Smart and Stylish Dress Sales Room," fails to give proper credit to the designer of the store interiors, including the complete lighting solution itself. While the work done by the electrical contractors was no doubt well executed and deserves adequate recognition, the designer and originator of the lighting system as well as the complete merchandising layout for the entire store was Victor Gruen Associates, an architectural, planning and engineeering firm with many years of background experience in store interiors of this type.

This particular J. Magnin store, one of many West Coast Magnin stores designed by Victor Gruen Associates (the Stockton and O'Farrell store was originally executed by this firm over 11 years ago), is now undergoing a phased remodeling program under the design direction of R. L. Baumfeld, partner in charge of design in the Los Angeles office of Victor Gruen Associates, assisted by Gere Kavanaugh, head of the interiors department.

The low ceiling structure of the second floor, formerly a mezzanine, imposed serious design difficulties, requiring considerable thought, time and even experimentation, before a satisfactory solution was obtained. Realizing that the heat generated by the amount of lighting required to maintain proper level of intensity would cause human discomfort at head height, Baumfeld placed the majority of the lighting source above an open plastic ceiling where heat radiation would be minimized. To further reduce heat, a cool, fluorescent system was specified and air conditioning registers were located above the surface of the ceiling to eliminate the discharge of air at face level.

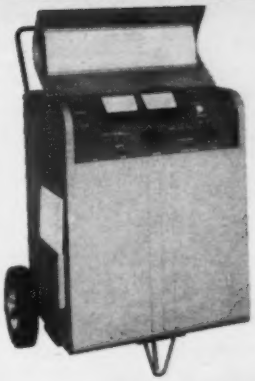
To reduce the monotony inherent in a low, luminous ceiling and to give the interiors a gaiety consistent with the merchandise and general decor, several clusters of highly colorful glass fixtures, designed by R. L. Baumfeld and executed by the Venini Glass Works in Murano, Italy, especially for this installation, were placed throughout the area, each cluster in a different pattern and color scheme. For added interest, one unit in each cluster was made solid in color, while all others are striped.

Other specially designed lighting fixtures, including a 12-armed chandelier and a dozen or so cylindrical-shaped fixtures mounted flush against the ceiling are located over various departments.

We agree that the entire lighting solution was a successful one, but its success was due largely to the combined efforts of Mr. Baumfeld, Miss Kavanaugh, our electrical engineer Mr. Tulchinsky and the Integrated Ceiling Co. of Los Angeles, which assembled a special ceiling mockup to study visual and environmental effects.

Mel Gooch, Architect, AIA
Victor Gruen Associates
Beverly Hills, Calif.

..HIGH VOLTAGE TESTING
of CABLES, MOTORS, GENERATORS
and All Electrical Equipment



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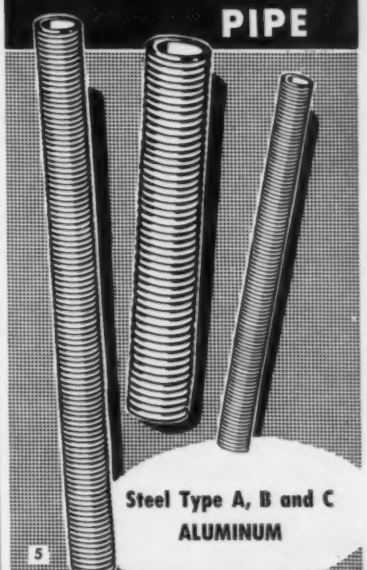

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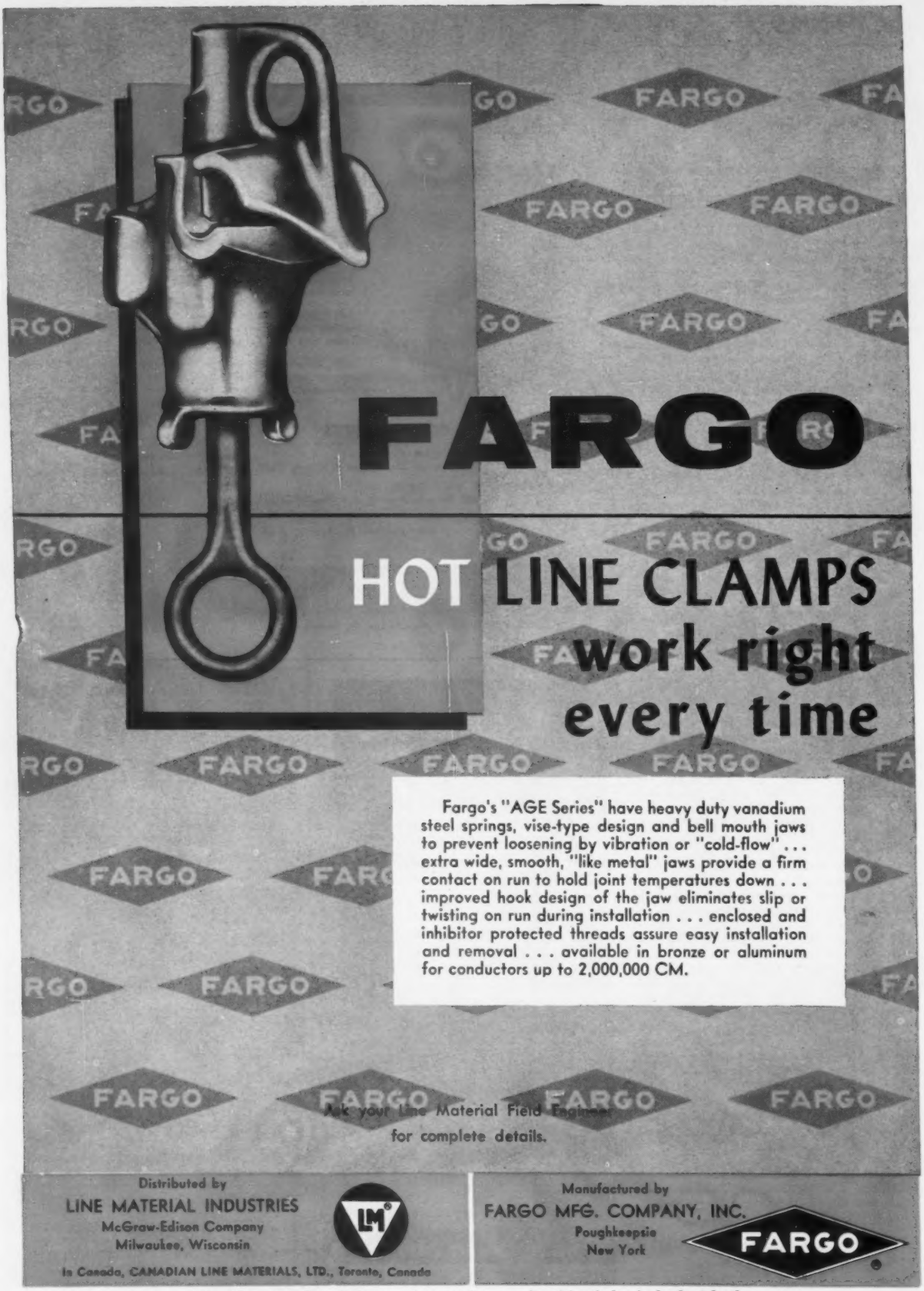
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Denver: Strong & Humphrey .....SH 4-1351
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Denver .....TAbor 5-7111
Salt Lake City.....ELgin 9-8771

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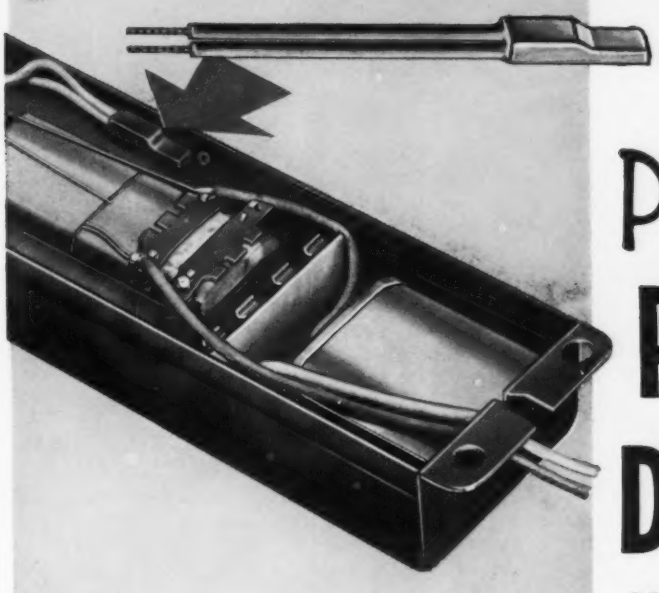

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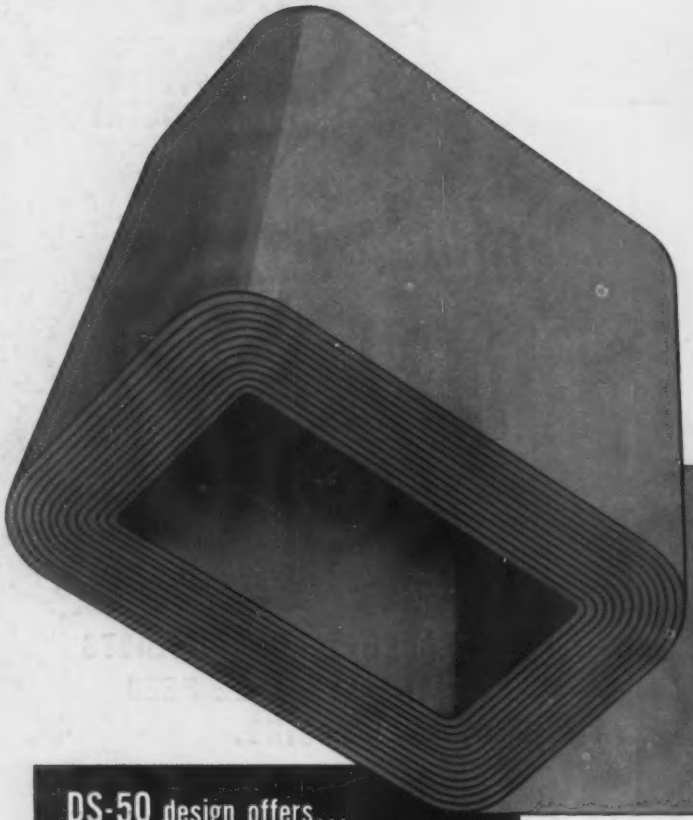

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